

A method of diagnosing cancer based on lipidomic analysis of a body fluid

Field of Art

- 5 The present invention relates to a method of diagnosing cancer based on lipidomic analysis of a body fluid which is suitable for high throughput screening with a high selectivity and specificity.

Background Art

- 10 Cancer is one of the most serious human diseases, which results in huge number of deaths worldwide. There are numerous types of cancer, typically classified according to the primary organ, when the tumor cells start to grow. Even the cancer of one particular organ has several disease subtypes resulting in large complexity and heterogeneity of this disease, which requires a personalized treatment to increase the chances for a full or at least a partial recovery of individual patients. Early diagnosis of the cancer is the
- 15 most critical issue investigated by many research teams throughout the world, because the early cancer diagnosis can significantly increase the chances for survival and recovery. Unfortunately, many cancer types have no or only minor symptoms at early stages, so the common situation is that the patient is diagnosed too late. The prognosis is much better when the disease is recognized earlier, but the currently available diagnostic methods are complex, expensive, and laborious, which is unsuitable for routine
- 20 population screening. Therefore, there is a need to continuously develop new methods for screening and diagnosing cancer and for distinguishing among various types of cancer, which would be fast, economical, with a limited invasiveness, suitable for routine high-throughput screening, with a sufficient sensitivity and specificity, i.e., low percentage of false positive and false negative results.
- Various methods based on specific biomarkers are investigated, using samples of body fluids, most
- 25 commonly blood. These tentative biomarkers are often proteins, glycoproteins, products of protein cleavage, and short RNA, such as miRNA. The diagnosis using these biomarkers usually relies on immunochemical methods or PCR.
- Breast cancer is besides skin cancer the most common cancer type for women and includes multiple sub-cancer types. Physical examination, mammography and fine-needle aspiration are common tools for the
- 30 diagnosis of breast cancer. On the other hand, prostate cancer is the most common cancer type for men. Symptoms may be associated with urinary dysfunction. Another cancer type is kidney cancer. Their main subtypes are renal cell carcinoma, transitional cell cancer and Wilms tumor. Symptoms may involve blood in the urine, a lump in the abdomen and weight loss. The survival rate of all these cancer types strongly depends on the cancer stage and on whether the cancer metastasized to other organs. In case of
- 35 cancer suspicion, ultrasound, computer tomography, or magnetic resonance imaging are employed. For cancer confirmation needle biopsy is usually performed, whereby a cancer tissue sample is examined under the microscope.

Pancreatic cancer belongs among the most lethal tumors with the lowest survival rate of all cancers. It is expected to become the second leading cause of cancer-related death in the US as well as Europe by the year 2020. Pancreatic cancer is very hard to be diagnosed at early stages. The pancreas is deep inside the body, so early tumors cannot be seen or felt by health care providers during routine physical examinations. People usually have no symptoms until the cancer has already spread to other organs. If people are at an increased risk of pancreatic cancer due to genetic predispositions or show signs and symptoms that can be associated with this disease, specific examinations and tests can be done. Imaging tests are most often performed in case of serious suspicion of pancreatic cancer: computed tomography, magnetic resonance imaging, abdominal or endoscopic ultrasound, cholangiopancreatography, somatostatin receptor scintigraphy, positron emission tomography, or angiography. Screening tests or examinations may be used to look for a disease in people who have no symptoms, and who have not had that disease before. However, the imaging tests used for patients with an increased risk or a suspicion of pancreatic cancer are not applicable for large-scale population screening, and moreover imaging tests may have sensitivity limitations in the detection of tumors at an early stage. For a conclusive diagnosis of pancreatic cancer, percutaneous, endoscopic, or surgical biopsy can be done, but again these invasive methods are not applicable for routine population screening.

So far, several types of blood tests have been considered to diagnose pancreatic cancer, such as carbohydrate antigen 19-9 (CA19-9), carcinoembryonic antigen (CEA), or Kirsten-ras (KRAS), but unfortunately low sensitivity and low specificity do not allow their use in the clinical practice for early diagnosis. No screening tests have so far been developed that would allow the detection of sufficiently early stages to lower the risk of dying from pancreatic cancer. Reliable detection of early stage pancreatic cancer is urgently needed, but at this time, no major professional groups recommend any routine screening for pancreatic cancer in people at risk.

It would be desirable to develop diagnostic methods based on other methodologies and other types of biomarkers. These screening methods have to fulfil several requirements, such as available treatment for early diagnosed disease with significantly better prognosis compared to late diagnosis, sufficiently high sample throughput to be able to perform at least a partial population screening of individuals at higher risk, the screening price has to be acceptable for the healthcare system in relation to the benefits obtained by early diagnosis, etc. The blood or urine collection is a common part of the preventative healthcare. For the population screening, a high throughput methodology based on blood analysis is indispensable. Once the blood analysis gives a positive result, further investigations such as imaging methods, i.e. magnetic resonance spectroscopy, have to be done. However, even though such test is urgently needed, there are just limited studies so far for the analysis of cancer from blood mainly based on the analysis of DNA, RNA or proteins. Previous studies showed that lipids play a crucial role in cancer development, as demonstrated in the analysis of tumor tissues and cell lines [E. Cífková, M. Holčápek, M. Lísa, D. Vrána, J. Gatěk, B. Melichar, *Anal. Bioanal. Chem.* 407 (2015) 991-1002, E. Cífková, M. Lísa, R. Hrstka, D. Vrána, J. Gatěk, B. Melichar, M. Holčápek, *Rapid Commun. Mass Spectrom.* 31 (2017) 253-263], but not

yet for collectable body fluids applicable for high-throughput screening. The first attempts towards the lipidomic analysis of human body fluids have been presented by Metanomics [US 2013/0140452, WO 2016/207391], but unfortunately sensitivities and specificities were too low for real-life applications.

The principal problem of body fluid analysis is that early stage tumor may have too small impact on the dysregulation of monitored metabolites and lipids, which may result in the situation that the effect of biological variability is larger than the effect of the studied cancer type, and then no statistically relevant differences can be discovered in body fluids.

The present invention aims at overcoming the problems and challenges of the current state of the art, and to provide a method of diagnosing cancer even in early stages, said method being usable for routine high-throughput population screening.

The notation of lipid compounds in this text is as follows: abbreviation of the class of the compounds, number of carbons: number of double bonds. The abbreviation of the class may be preceded by information about isotopic labeling, if relevant. More details about the description of lipid annotations and abbreviations used in this patent application is given in Table 1.

Table 1. Lipid nomenclature and abbreviations used in this application.

Lipid category	Lipid class/subclass (abbreviation)		Examples of lipid annotation for particular level		
			Lipid species level ^a	Fatty acyl/alkyl level ^b	Fatty acyl/alkyl position level
Glycerolipids	Monoacylglycerols (MG)		MG 18:0	MG 18:0	MG 18:0/0:0/0:0
	Diacylglycerols (DG)		DG 34:1	DG 18:1_16:0	DG 18:1/0:0/16:0
	Triacylglycerols (TG)		TG 57:3	TG 19:1_19:1_19:1	TG 19:1/19:1/19:1
Glycero-phospholipids	Phosphatidylcholines (PC)	Diacyl ^c	PC 34:1	PC 16:0_18:1	PC 16:0/18:1
		Alkyl-acyl or plasmalogen ^c	PC O-34:1 or PC P-34:0	PC O-16:0_18:1 or PC P-16:0_18:0	PC O-16:0/18:1 or PC P-16:0/18:0
	Phosphatidic acids (PA)		PA 34:1	PA 16:0_18:1	PA 16:0/18:1
	Phosphatidylethanolamines (PE)		PE 34:1	PE 16:0_18:1	PE 16:0/18:1
	Phosphatidylglycerols (PG)		PG 34:1	PG 16:0_18:1	PG 16:0/18:1
	Phosphatidylinositols (PI)		PI 34:1	PI 16:0_18:1	PI 16:0/18:1
	Phosphatidylserines (PS)		PS 34:1	PS 16:0_18:1	PS 16:0/18:1
	Lysophospholipids (prefix L)		LPC 18:1	LPC 18:1	LPC 18:1/0:0
Sphingolipids ^d	Ceramides (Cer)		Cer 34:1	Cer d18:1/16:0	
	Sphingomyelins (SM)		SM 34:1	SM d18:1/16:0	
	Hexosylceramides (HexCer)		HexCer 34:1	HexCer d18:1/16:0	
	Dihexosylceramides (Hex2Cer)		Hex2Cer 34:1	Hex2Cer d18:1/16:0	
	Sulfatides (Sul or SHexCer)		SHexCer 34:1	SHexCer d18:1/16:0	
	Sulfodihexosylceramides (SHex2Cer)		SHexCer 34:1	SHexCer d18:1/16:0	
Sterol Lipids	Cholesteryl esters (CE)		CE 16:0		

^a Information on the total number of carbon atoms and double bonds of present fatty acyls, alkyls, or sphingoid backbone for particular lipid class or subclass.

^b Particular information about present fatty acyls, alkyls, or sphingoid backbone for particular lipid class or subclass.

^c Bond type subclasses of PC (applicable for other classes of glycerophospholipids).

^d Annotation of lipid species level for sphingolipids is based on the common assumption of a sphingoid base with two hydroxyl groups and no hydroxylation of N-acyl. In case of the presence of additional hydroxyl on the ceramide part of sphingolipids

5 without any specification of its position, the OH in parentheses is placed behind the CN:DB number.

Summary of the Invention

10 The present invention provides a method using lipidomic analysis for the diagnosis of a plurality of human cancer types. The major advantage of the present invention is that the lipidomic profiling works well for all cancer stages including the most early stages, unlike a previously published work based on the proteomic analysis combined with other methodologies, where the sensitivity for stage 1 was only 40% [J.D. Cohen et al., Science 359 (2018) 926], which is truly not valuable for early diagnosis. The basic and rather simple hypothesis explaining the success of lipidomic analysis for cancer screening is that the

15 tumor cells are so quickly divided that these cells require a large number of building blocks for the preparation of lipid bilayers of new tumor cells. This process is much faster than conventional cell division in the healthy organism, therefore the lipidomic composition of tumor and normal cell must be different as well, and these changes are also reflected in collectable body fluids.

20 The principal problem is that early stage tumors as well as different cancer types may have too small impact on the dysregulation of monitored metabolites and lipids in body fluids. This may leads to the fact that the effect of biological variability is larger than the effect on studied cancer types and then no statistically relevant differences can be discovered in body fluids.

25 The present invention aims at overcoming the problems and challenges of the current state of the art, and to provide a method of diagnosing cancer from the analysis of biological fluids, which is also capable of distinguishing among multiple cancer types even in early stages, said method being usable for routine high-throughput population screening.

30 The present invention thus provides a method of diagnosing cancer based on lipidomic analysis of a body fluid taken from the body of a patient, comprising the steps of:

- spiking of the sample with a set of internal standards comprising at least one internal standard for each lipid class present in the sample,
- subsequently processing the sample by liquid-liquid lipidomic extraction or by solid phase lipidomic
- 35 extraction,
- measurement of the processed sample by a mass spectrometry method,
- determining concentrations for at least 51, more preferably for all lipids present at a level above detection threshold of the mass spectrometry method, using the internal standards for the corresponding

lipid classes for the quantitation, or using relative concentrations, or using ratios of concentrations and/or signal intensities,

- statistical evaluation of the determined concentrations of the lipids, said statistical evaluation determining the level of probability of the patient suffering from cancer, or optionally from a specific type of cancer, based on the determined lipid concentrations compared to a cancerous pattern, or optionally a specific cancerous pattern, and a non-cancerous pattern, wherein the cancerous pattern or the specific cancerous pattern and the non-cancerous pattern are determined by statistical analysis of the lipid concentrations for a group of known cancer samples and non-cancer samples, and wherein the statistical evaluation is done separately for males and females.

The method of the invention allows to distinguish between a healthy person and a person suffering from a cancer, as well as to distinguish between various types of cancer. The cancerous pattern generally indicates that the patient suffers from a cancer, while the specific cancerous pattern indicates that the patient suffers from a specific type of cancer.

In one embodiment of the present invention, a method of diagnosing pancreatic cancer based on lipidomic analysis of a body fluid taken from the body of a patient is provided, comprising the steps of:

- spiking of the sample with a set of internal standards comprising at least one internal standard for each lipid class present in the sample,

- subsequently processing the sample by liquid-liquid lipidomic extraction,

- measurement of the processed sample by a mass spectrometry method,

- determining concentrations for at least 31 or for at least 51 lipids, preferably at least 60 or at least 120 lipids or at least 230, more preferably for all lipids present at a level above detection threshold of the mass spectrometry method, using the internal standards for the corresponding lipid classes for the quantitation, or using relative concentrations, or using ratios of concentrations and/or signal intensities,

- statistical evaluation of the determined concentrations of the lipids, said statistical evaluation determining the level of probability of the patient suffering from pancreatic cancer based on the determined lipid concentrations compared to a pancreatic cancerous pattern and a non-cancerous pattern, wherein the cancerous pattern and the non-cancerous pattern are determined by statistical analysis of the lipid concentrations for a group of known pancreatic cancer samples and non-cancer samples, and wherein the statistical evaluation is done separately for males and females.

In this embodiment, the at least 31 lipids useful in method of diagnosing pancreatic cancer include:

Lipid
HexCer d18:1/16:0; HexCer d18:1/15:1 (1OH)
SM 34:1
HexCer d18:1/24:1; HexCer d18:1/23:2 (1OH)
PE 34:1; PE P-35:0

PC 32:0; PC O-33:0
PE 36:4; PE P-37:3
PC 34:1; PC P-35:0
PE 34:2; PE P-35:1
PC P-34:0; PC 33:1
DG 36:2
Cer d18:1/24:1; Cer d18:1/23:2 (1OH)
CE 16:0
SM 41:1
SM 41:2
PC 34:4; PC P-35:3
HexCer d18:1/24:0; HexCer d18:1/23:1 (1OH)
PE P-36:3; PE 35:4
PE P-38:4; PE 37:5
PE P-38:5; PE 37:6
PE P-36:2; PE 35:3
SM 32:1
HexCer d18:1/22:0; HexCer d18:1/21:1 (1OH)
PE P-38:3; PE 37:4
PC P-38:2; PC 37:3
PE P-40:5; PE 39:6
PE 36:0; PE P-38:6
PE 38:0; PE P-40:6, PE O-39:0
PE P-36:3; PE 35:4
PC P-34:1; PC 33:2
PC P-36:2; PC 35:3
DG 34:3

The term “body fluid” includes body fluids and components of body fluids. The body fluid for use in this invention is preferably selected from plasma, serum, blood, urine, oncosomes, exosomes, extracellular vesicles. The isolation of exosomes and other extracellular vesicles (EV) from body fluids (oncosomes and microvesicles) or cell-culture media is known in the art and typically performed by differential centrifugation or ultracentrifugation, often combined with sucrose density gradients.

In preferred embodiments, the concentrations of at least 51, or at least 120, or at least 230, or at least 400, or at least 406, or at least 440, or at least 450, or at least 500 lipids are determined.

In one preferred embodiment, the concentrations of at least 51 lipids are determined when the body fluid is blood, plasma or serum.

A particularly preferred set of at least 51 lipids, the concentration of which shall be determined in the methods of the present invention, is shown in Table 2 below. A more preferred set of lipids is shown in Table 3 below. These lipids are particularly useful when the body fluid is blood, plasma or serum.

In another preferred embodiment, the concentrations of at least 75 lipids are determined when the body fluid is urine. A particularly preferred set of at least 75 lipids is shown in Table 4 below.

- 5 The patient is a mammal, preferably a human.

The specific types of cancer include kidney, prostate, breast, lungs, stomach, pancreatic, ovarian, head and neck, colon, liver, colorectal, esophagus, small intestine cancer, bladder, brain, cervical, thyroid, laryngeal, skin cancers, etc.

- 10 Preferably, the specific types of cancer include kidney, prostate, breast, lungs, pancreatic and stomach cancers.

The internal standards must be lipid-type compounds, structurally close to the relevant lipid class. Typically, the internal standards are compounds having the structure (in particular the polar head structure) typical for the relevant lipid class but containing fatty acyls with shorter chains than naturally occurring lipids (e.g. chains 12:0 or 14:0) or fatty acyls with odd number of carbon atoms (e.g. chains 17:0, 17:1 or 19:1) or isotopically labelled analogues (e.g. D7-Chol, D7-CE 16:0).

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The lipid classes are as follows:

Cholesterylesters (CE)	Lysophosphatidylserines (LPS)
Ceramides (Cer)	Monoacylglycerols (MG)
Diacylglycerols (DG)	Phosphatidic acids (PA)
Dihexosylceramides (Hex2Cer)	Phosphatidylcholines (PC)
Hexosylceramides (HexCer)	Phosphatidylethanolamines (PE)
Cholesterol	Phosphatidylglycerols (PG)
Lysophosphatidic acids (LPA)	Phosphatidylserines (PS)
Lysophosphatidylcholines (LPC)	Sphingomyelins (SM)
Lysophosphatidylethanolamines (LPE)	Sulfohexosylceramides (SulfoHexCer)
Lysophosphatidylglycerols (LPG)	Triacylglycerols (TG)

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An example of a set of internal standards (IS) is the following list:

D7-CE 16:0	LPE 14:0	PG 14:0/14:0
Cer d18:1/12:0	LPG 14:0	PS 14:0/14:0
DG 12:1/12:1	LPA 14:0	SM d18:1/12:0
Hex2Cer d18:1/12:0	MG 19:1	SulfoHexCer d18:1/12:0
HexCer d18:1/12:0	PA 14:0/14:0	TG 19:1/19:1/19:1
D7-Chol	PC 14:0/14:0	LPS 17:1

LPC 17:0	PE 14:0/14:0	
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The notation of lipid compounds in this text is as follows: abbreviation of the class of the compounds, number of carbons: number of double bonds. The abbreviation of the class may be preceded by information about isotopic labeling, if relevant.

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Due to the addition of the internal standard before sample processing, slight differences due to for instance pipetting errors can be compensated as the internal standard is affected in the same way as the target compounds. This ensures a better reliability of the quantitation of individual lipids.

10 Liquid-liquid lipidomic extractions are known in the art. Solvents may be used, selected from chlorinated alkanes, dialkyl ethers, alcohols, and water mixtures, which forms bilayer systems containing organic and aqueous phases. Preferably, chloroform, methyl-tert-butyl ether, methanol, ethanol, propanol, and/or butanol are used. Most preferably, chloroform – methanol – water system is used, as described e.g. in E. Cífková, M. Holčápek, M. Lísa, D. Vrána, J. Gatěk, B. Melichar, *Anal. Bioanal. Chem.* 407 (2015) 991-
15 1002; or in E. Cífková, M. Lísa, R. Hrstka, D. Vrána, J. Gatěk, B. Melichar, M. Holčápek, *Rapid Commun. Mass Spectrom.* 31 (2017) 253-263. The organic phase of liquid-liquid extraction system containing lipids is collected and used for further processing. As the migration and solubility of the components of the sample are time-dependent, it is highly preferred that the extraction step is always performed in the same way for all the samples measured in one batch, in particular that the extraction is
20 performed over the same period of time for each sample. The organic phase is typically processed by evaporation of the organic solvent and re-dissolving the residue in the solvent for mass spectrometry measurement. Suitable solvents for mass spectrometry measurements include chlorinated alkanes, alkanes and alcohols, preferably chloroform or dichloromethane, hexane and C1-C4 alcohols, most preferably a mixture of chloroform and 2-propanol (e.g., in volume ratio 1:1) or hexane : 2-propanol : chloroform
25 7:1.5:1.5 or chloroform – methanol – 2-propanol (1:2:4, v/v/v). Further components may be added, e.g., ammonium acetate, acetic acid, etc. Alkanes, unless defined otherwise, mean C1-C6 alkanes, preferably C1-C4 alkanes.

30 It is preferred to remove proteins from the sample during or after the liquid-liquid extraction, as proteins may undesirably interfere with the analysis of lipids.

The mass spectrometry method is selected from shotgun mass spectrometry, liquid chromatography – mass spectrometry (LC/MS), ultrahigh-performance liquid chromatography – mass spectrometry (UHPLC/MS), supercritical fluid chromatography – mass spectrometry (SFC/MS), ultrahigh-performance
35 supercritical fluid chromatography – mass spectrometry (UHPSFC/MS), and matrix-assisted laser desorption/ionization mass spectrometry (MALDI/MS).

The method of the present invention benefits from the use of a pooled sample. A pooled sample is a sample prepared by mixing identical volumes of several samples, wherein the mixed samples include samples from cancer patients and healthy volunteers. The ratio of samples originating from males to samples originating from females should be approximately the same as in the measured batch of samples. The term „approximately the same“ refers to deviation from the ratio of male:female in the measured batch at most by 20 %, preferably at most by 10 %, more preferably at most by 5 %. The pooled sample is preferably obtained by pooling 50-100 samples.

Concentrations of internal standards in the mixture were carefully researched in order to be applicable for all mass spectrometry based methods used in this invention. The concentration of the internal standard should be preferably in the concentration range of naturally occurring lipids. However, as the concentration range varies significantly within the lipid class, it is preferred to use the concentration between 10 and 100% of the concentration of the most abundant naturally occurring lipid species within the respective class, more preferably between 20 and 80%.

The pooled sample, processed in the same way as any other sample, i.e., spiked with internal standard mixture and subjected to liquid-liquid extraction and any other sample processing steps, is used for the full validation and quality control during the mass spectrometry measurements. The order of samples is randomized in sample measurement sequences to avoid measurements of non-cancerous and cancerous samples in a certain portion of the measurement sequence.

The pooled sample may be used for observing intra-day accuracy and intra-day precision, as well as inter-day accuracy and inter-day precision.

Furthermore, it is advantageous to prepare test samples or pooled samples spiked with varying concentrations of the internal standard mixture.

The limit of detection (LOD) of a lipid is preferably determined based on signal to noise ratio, e.g., such as $S/N = 3$.

The pooled sample spiked with varying concentrations of the internal standard mixture is used for determining the lower limit of quantitation (LLOQ) and the upper limit of quantitation (ULOQ), said limits corresponding to the first and the last points of linearity range of the calibration curve. The calibration curve is the dependence of signal on the concentration of a lipid. The linearity range of calibration curve is an interval from LLOQ to ULOQ, where the concentration of lipids can be determined.

The concentrations for all lipids present at a level above LLOQ of the mass spectrometry method are also commonly called „lipidomic profile“.

- 5 The quantitation (determining concentrations) for all lipids present at a level above LLOQ and below ULOQ of the mass spectrometry method, using the internal standards for the corresponding lipid classes for the quantitation, preferably comprises the following procedures and corrections:
- isotopic correction (deisotoping), i.e., correction of signal intensity of a lipid having due to isotopic contribution M+2 of another lipid with a molecular weight being 2 mass units lower than said lipid (e.g.,
 - 10 isotopic interference from the lipid with one additional double bond) or due to isotopic contribution M+1 of another lipid with a molecular weight 1 mass unit lower than said lipid (e.g., interferences between PC and SM subgroups). The correction is done by subtracting calculated M+2 (or M+1) relative intensity based on known intensity in measured spectra.
 - zero filling procedure in which the signals of lipid species which are not detected for particular sample,
 - 15 are replaced by 50 to 100 %, preferably by 60 to 100 %, more preferably by 60 to 70% or by 80 to 90 %, or by 70 to 100 % or by 67 % or by 80 %, of the minimum concentration observed for said lipid species in all samples.

The accuracy and reliability of quantitation is ensured or improved by the following features:

- 20 - use of at least one exogenous lipid class internal standard for the quantitation of lipid species in each class,
- coelution and coionization of lipid (sub)class internal standards and analytes from the same lipid class using either lipid class separation chromatography method coupled to mass spectrometry (MS) or MS without any chromatographic separation. This co-processing is ensured by the addition of the internal
 - 25 standard before the sample is processed,
 - use of the pooled sample spiked with the internal standards as quality control sample injected after a predetermined number of samples,
 - measurement control by extracting the signal response of each internal standard in each sample and evaluation of signal response of those over the time period of the measurement sequence daily,
 - 30 - zero filling procedure,
 - isotopic correction.

These features prevent one or more of: low reproducibility, lack of robustness, signal shifts over time, ion suppression/enhancement, carry-over effects, and response change of mass spectrometer due to contamination.

- 35 These features thus help to control the quality of measurements by prevention of low reproducibility, lack of robustness, signal shifts over time, ion suppression/enhancement, carry-over effects, and response change of mass spectrometer due to contamination.

When several hundreds of lipids are determined in hundreds of samples, it may happen that the expected signal is not detected for some lipid molecules due to various reasons, and then the concentration should be reported as “below LLOQ” in accordance with established analytical practice. This well-established analytical approach does not work well in case of lipidomic quantitation, and the MDA based on such approach would provide poor resolution of healthy / disease groups, and may not provide acceptable sensitivity and selectivity for the detection of cancer. This approach is adapted to cases in which all missing signals correspond to the situation that the true concentration of the analyte is below LLOQ, for example the determination of low number of analytes well separated by chromatography. However, the situation in lipidomic quantitation is very different, because quantify ca. 150-400 lipids per sample are quantified and many of them (or all in case of shotgun) are co-eluting, which may result in the absence of signal due to other reasons than the concentration below LLOQ, mainly due to ion suppression or other reasons causing the signal drop, including the system contamination, mobile phase impurity, bleeding of chromatographic column, etc. The complexity of lipidomic analysis is enormous, and it is a natural situation that some signals are not properly recorded and processed regardless of the best analytical practice and careful analytical work. Therefore, we have developed a new zero filling approach where the values which are missing for any reason are replaced by 75 to 85 %, preferably by 80%, of the minimum concentration observed for this lipid species in all samples. This approach significantly improves the quality of subsequent statistical analysis. Our preliminary results show that when the zero-filling approach is neglected, the quality of cancer detection is significantly worse or impossible. Afterwards the average and the standard deviation of the duplicates are calculated.

The statistical evaluation is preferably performed by multivariate data analysis (MDA). The MDA methods may be non-supervised statistical methods such as principal component analysis (PCA) or supervised statistical methods such as orthogonal projections to latent structures discriminant analysis (OPLS-DA).

The „cancerous pattern“ means the pattern of lipid concentrations typical for samples of a body fluid obtained from patients suffering from a cancer. It is usually obtained by statistical analysis of the samples obtained from patients suffering from various types of cancer versus samples obtained from healthy volunteers.

The “specific cancerous pattern” means the pattern of lipid concentrations typical for samples of a body fluid obtained from patients suffering from a specific type of cancer. It is usually obtained by statistical analysis of the samples obtained from patients suffering from the specific type of cancer versus samples obtained from healthy volunteers, and/or versus samples obtained from patients suffering from other specific types of cancer.

The „pancreatic cancerous pattern“ means the pattern of lipid concentrations typical for samples of a body fluid obtained from patients suffering from pancreatic cancer. It is usually obtained by statistical analysis of the samples obtained from patients suffering from pancreatic cancer versus samples obtained from healthy volunteers.

The „non-cancerous pattern“ means the pattern of lipid concentrations typical for samples of a body fluid obtained from healthy volunteers, i.e., from subjects not suffering from cancer. The term „non-cancerous sample“ or “non-cancer sample” refers to a sample of a body fluid obtained from healthy volunteers, i.e., from subjects not suffering from cancer.

Preferably, the statistical evaluation involves

- data pre-processing such as centering, scaling, and/or transformation. The centering correlates the changes relative to the average of the data set. The scaling unifies the impact of different concentration ranges on the model (Unit Variance (UV) and Pareto scaling) so that low concentrations (maybe equally important) are not masked by very abundant concentrations. The logarithmic transformation assembles the data to the normal distribution. A proper pre-processing has a significant influence on the quality of results.

- PCA analysis used for identification of outliers, measurement failures as well as other influential factors.

The PCA analysis may also visualize differences between groups as well as cluster the quality control (QC) samples in comparison to other samples.

- discrimination analysis (OPLS-DA) for group separation of cancer patients and healthy volunteers. The discrimination analysis is performed for males and females separately.

- assignment of the statistical parameters as well as the evaluation of the prediction power.

The statistical methods are first used to build statistical models (cancerous patterns, specific cancerous patterns, and non-cancerous patterns) based on lipidomic profiles of body fluids of healthy volunteers and diagnosed cancer patients. These statistical models are then used for visualization of differences of the cancerous and non- cancerous pattern, as well as for the determination of the level of probability of the patient suffering from cancer or from a specific cancer (such as pancreatic cancer), or being healthy, based on the determined lipid concentrations resulting in a cancerous pattern, a specific cancerous pattern or a non-cancerous pattern, respectively.

Preferably, in the step of evaluation using statistical data, the evaluated sample is first evaluated for the probability of the evaluated patient suffering from cancer or being healthy, and subsequently, provided that the evaluated patient is determined to have a probability of suffering from cancer being above a pre-

determined level (e.g., the pre-determined level may be 50%, or 60%, or 70%, or 80%, or 90%), the evaluated sample is evaluated for determining the specific cancer.

The sensitivity and specificity describe the prediction power of the method to correctly assign samples from healthy volunteers or cancer patients groups. The sensitivity and specificity values should be over 70%, preferably over 80% or over 85%, more preferably over 90% for samples of known and unknown classification. In some embodiments, the sensitivity and specificity values achieved are over 95% for samples of known and unknown classification.

Based on the data obtained by the inventors, the sensitivity and selectivity of the method of the invention for pancreatic cancer, for example for OPLS-DA models, is 100% for samples with known classification (292 subjects tested), and 95% for samples with unknown classification (73 subjects tested). Such sensitivity and selectivity is better than selectivity and sensitivity achievable by any other known method for pancreatic cancer diagnosis. Data obtained by the inventors also show that patients with stages 1-2 (early stages) can be identified in the screening using the method of the invention. This represents a significant advantage of the present method. The capability to identify early stage cancers results in identification of patients at a stage when the cancer can be successfully treated.

The sample throughput of the methodology of the invention is at least 4000 samples or preferably at least 10 000 samples per year and one mass spectrometry apparatus at current level of automation of standard mass spectrometry labs. Known methods of multiplexing and higher automation may further increase the sample throughput.

Suitable sets of lipids to be determined for diagnosing the presence of a cancer disease, or for diagnosing a specific type of cancer are usually obtained by an analysis of all detectable lipids for a group of healthy volunteers and cancer patients. The lipids which are present in different amounts in the healthy vs. cancer samples or healthy vs. specific cancer samples or first specific cancer vs. second specific cancer samples are preferred for inclusion into the sets of lipids to be determined.

Table 2. The following table shows a minimum list of lipid species the concentrations of which are determined in the present invention (preferably in blood, plasma or serum samples). Optionally, the concentrations of further lipids may be determined.

Sphingolipids					
Cer 34:1	SM 34:2	SM 40:1	SM 42:2	Sul 40:1	Sul 42:1
Cer 42:1	SM 36:1	SM 40:2	SM 42:3	Sul 40:1(OH)	Sul 42:1(2OH)
Cer 40:1	SM 36:2	SM 41:1	SM 43:1	Sul 40:2(OH)	Sul 42:1(OH)
Cer 42:2	SM 38:1	SM 41:2	Sul 34:0(OH)	Sul 41:1	

SM 34:1	SM 39:1	SM 42:1	Sul 34:2(OH)	Sul 41:1(OH)	
Glycerophospholipids					
LPC 16:0	LPC 18:2	PC 34:1	PC 36:3	PC O-34:2/P-34:1	PC O-36:5/P-36:4
LPC 18:0	PC 32:0	PC 34:2	PC 36:4	PC O-34:3/P-34:2	PE 34:1
LPC 18:1	PC 32:2	PC 36:2	PC 38:4	PC O-36:3/P-36:2	
Glycerolipids					
TG 49:1	TG 50:4	TG 50:5	TG 51:4	TG 53:4	TG 55:5

Minimum list of lipid species listed in Table 2 is particularly suitable for the differentiation of cancer and healthy samples. In general, the prediction power reflected in the sensitivity and specificity of a model is the higher the more species are included to build the statistical model. Therefore, it is advantageous to quantify as many lipids as possible in the biological fluid. It is possible to reduce the variables i.e. by including just statistically relevant species as determined by the P-value and/or the VIP value (p-value < 0.05 and VIP value > 1). For the generation of the minimum list of lipid, only those species are included which fulfil both criteria when analysing various cancer types. A compromise for all three tested MS based methods was performed, thus the list presented in Table 2 is generally applicable in the method of the present invention.

Table 3. The following table shows a preferred set of lipids the concentrations of which are preferably determined in the present invention in blood, plasma or serum samples. Optionally, the concentrations of further lipids may be determined.

Glycerophospholipids					
LPC 15:0	PC 36:2	PC O-36:5	PE 37:3	PE O-36:6	PI 34:2
LPC 16:0	PC 36:3	PC O-37:1	PE 37:5	PE O-36:7	PI 34:3
LPC 16:1	PC 36:4	PC O-37:2	PE 37:6	PE O-37:1	PI 35:0
LPC 18:0	PC 36:5	PC O-37:3	PE 38:0	PE O-37:2	PI 35:1
LPC 18:1	PC 37:3	PC O-38:2	PE 38:1	PE O-37:3	PI 36:1
LPC 18:2	PC 37:4	PC O-38:3	PE 38:2	PE O-38:0	PI 36:2
LPC 20:3	PC 37:5	PC O-38:4	PE 38:4	PE O-38:1	PI 36:3
LPC 20:4	PC 37:6	PC O-38:5	PE 38:5	PE O-38:2	PI 36:4
LPC 22:6	PC 38:2	PC O-38:6	PE 38:6	PE O-38:3	PI 38:1
LPC O-16:0	PC 38:3	PC O-39:2	PE 38:7	PE O-38:4	PI 38:2
LPE 16:0	PC 38:4	PC O-39:3	PE 39:0	PE O-38:5	PI 38:3
LPE 18:0	PC 38:5	PC O-40:5	PE 39:4	PE O-38:6	PI 38:4
LPE 18:1	PC 38:6	PC O-40:6	PE 39:5	PE O-39:0	PI 38:5
LPE 18:2	PC 39:5	PC O-40:9	PE 39:6	PE O-39:1	PI 40:0
LPE 20:4	PC 39:6	PE 32:1	PE 40:4	PE O-39:2	PI 40:4
LPE 22:5	PC 40:4	PE 33:1	PE 40:5	PE O-40:0	PI 40:5
LPE 22:6	PC 40:5	PE 33:2	PE 40:6	PE O-40:4	PI 40:6
PC 30:0	PC 40:6	PE 34:0	PE 40:7	PE O-40:5	PS 34:0

PC 32:0	PC O-33:0	PE 34:1	PE 41:2	PE O-40:6	PS 36:1
PC 32:1	PC O-33:1	PE 34:2	PE 42:9	PE O-40:7	PS 36:4
PC 32:2	PC O-33:2	PE 34:3	PE O-33:1	PE O-40:8	PS 36:5
PC 34:1	PC O-34:1	PE 35:1	PE O-34:1	PE O-40:9	PS 37:0
PC 34:2	PC O-34:2	PE 35:2	PE O-34:2	PE O-42:2	PS 38:1
PC 34:3	PC O-34:3	PE 35:3	PE O-35:1	PG 32:1	PS 38:2
PC 34:4	PC O-35:1	PE 35:5	PE O-35:2	PG 36:0	PS 38:3
PC 35:1	PC O-35:2	PE 36:1	PE O-35:3	PG 36:4	PS 38:4
PC 35:2	PC O-35:3	PE 36:2	PE O-36:1	PI 32:0	PS 38:6
PC 35:3	PC O-36:1	PE 36:3	PE O-36:2	PI 32:1	PS 38:7
PC 35:4	PC O-36:2	PE 36:4	PE O-36:3	PI 33:0	PS 42:1
PC 35:5	PC O-36:3	PE 36:5	PE O-36:4	PI 33:1	
PC 36:1	PC O-36:4	PE 37:0	PE O-36:5	PI 34:1	
Sphingolipids					
Cer 33:2 (OH)	Hex2Cer 33:2 (OH)	SM 34:0	SM 41:3	Sul 38:2	Sul 42:3 (OH)
Cer 34:1	Hex2Cer 34:1	SM 34:1	SM 42:1	Sul 38:2 (OH)	SulfoHex2Cer 34:1
Cer 34:2	Hex2Cer 39:1 (OH)	SM 34:2	SM 42:2	Sul 40:0 (2OH)	SulfoHex2Cer 40:1
Cer 34:3	Hex2Cer 39:2 (OH)	SM 35:1	SM 42:3	Sul 40:0 (OH)	SulfoHex2Cer 42:1
Cer 35:3 (OH)	Hex2Cer 40:1	SM 36:0	SM 42:4	Sul 40:1	SulfoHex2Cer 42:2
Cer 36:2	Hex2Cer 41:3 (OH)	SM 36:1	SM 43:1	Sul 40:1 (OH)	GM3 34:1
Cer 36:3	Hex2Cer 42:2	SM 36:2	SM 43:2	Sul 40:2	GM3 34:2
Cer 36:4	HexCer 33:2 (OH)	SM 37:0	SM 43:3	Sul 40:2 (OH)	GM3 36:1
Cer 39:2 (OH)	HexCer 34:1	SM 37:1	Sul 32:1 (OH)	Sul 41:1	GM3 36:2
Cer 40:1	HexCer 39:2 (OH)	SM 38:0	Sul 34:0 (OH)	Sul 41:1 (OH)	GM3 38:1
Cer 40:2	HexCer 40:1	SM 38:1	Sul 34:1	Sul 41:2	GM3 38:2
Cer 40:2 (OH)	HexCer 41:2 (OH)	SM 38:2	Sul 34:1 (OH)	Sul 41:2 (OH)	GM3 40:2
Cer 41:1	HexCer 41:3 (OH)	SM 39:1	Sul 34:2	Sul 42:0 (2OH)	GM3 40:1
Cer 41:2 (OH)	HexCer 42:1	SM 39:2	Sul 34:2 (OH)	Sul 42:1	GM3 41:1
Cer 41:3 (OH)	HexCer 42:2	SM 40:0	Sul 35:1	Sul 42:1 (2OH)	GM3 41:2
Cer 42:1	HexCer 42:2 (OH)	SM 40:1	Sul 36:1	Sul 42:1 (OH)	GM3 42:3
Cer 42:2	HexCer 43:1	SM 40:2	Sul 36:1 (OH)	Sul 42:2	GM3 42:2
Cer 42:2 (OH)	SM 32:1	SM 40:3	Sul 37:1	Sul 42:2 (2OH)	GM3 42:1
Cer 42:3	SM 32:1	SM 41:1	Sul 38:1	Sul 42:2 (OH)	GM3 42:2 (OH)
Cer 43:1	SM 33:1	SM 41:2	Sul 38:1 (OH)	Sul 42:3	GM3 42:1 (OH)
Glycerolipids					
MG 16:0	DG 36:1	TG 47:2	TG 50:5	TG 53:4	TG 56:4
MG 16:1	DG 36:2	TG 48:0	TG 51:1	TG 53:5	TG 56:5

MG 18:0	DG 36:3	TG 48:1	TG 51:2	TG 54:1	TG 56:6
MG 18:1	DG 36:4	TG 48:2	TG 51:3	TG 54:2	TG 56:7
MG 18:2	TG 42:2	TG 48:3	TG 51:4	TG 54:3	TG 56:8
MG 19:0	TG 44:0	TG 48:4	TG 51:5	TG 54:4	TG 57:1
DG 30:0	TG 44:1	TG 49:0	TG 51:6	TG 54:5	TG 58:0
DG 32:0	TG 44:2	TG 49:1	TG 52:1	TG 54:6	TG 58:2
DG 32:1	TG 45:0	TG 49:2	TG 52:2	TG 54:7	TG 58:3
DG 32:2	TG 45:1	TG 49:3	TG 52:3	TG 54:8	TG 58:4
DG 34:0	TG 46:0	TG 50:0	TG 52:4	TG 55:4	TG 58:5
DG 34:1	TG 46:1	TG 50:1	TG 52:5	TG 55:5	TG 58:6
DG 34:2	TG 46:2	TG 50:2	TG 52:6	TG 55:6	TG 58:7
DG 34:3	TG 47:0	TG 50:3	TG 53:2	TG 56:1	TG 58:8
DG 36:0	TG 47:1	TG 50:4	TG 53:3	TG 56:2	TG 58:8
Sterol lipids					
CE 14:0	CE 16:1	CE 18:2	CE 20:4	CE 22:6	cholesterol sulfate
CE 16:0	CE 18:1	CE 18:3	CE 20:5	cholesterol	cholesterol sulfate (OH)

Table 4. The following table shows a preferred set of lipids the concentrations of which are preferably determined in the present invention for urine samples. Optionally, the concentrations of further lipids may be determined.

Sterol conjugates	Sulfoglycosphingolipids	
hydroxypregnenolone sulfate	Sul 34:1	Sul 42:1 (2OH)
lithocholic acid glycine conjugate	Sul 34:1 (OH)	Sul 42:0 (2OH)
cortisol sulfate	Sul 36:1	Sul 43:1 (2OH)
glycochenodeoxycholic acid	Sul 36:1 (OH)	Sul 43:0 (2OH)
lithocholic acid sulfate	Sul 38:1	SulfoHex ₂ Cer 34:1
testosterone glucuronide	Sul 38:1 (OH)	SulfoHex ₂ Cer 34:1 (OH)
glycocholic acid	Sul 40:2	SulfoHex ₂ Cer 36:1
androsterone glucuronide / dihydrotestosterone glucuronide	Sul 40:1	SulfoHex ₂ Cer 38:1
	Sul 41:2	SulfoHex ₂ Cer 38:1 (OH)
cholesterol sulfate	Sul 40:2 (OH)	SulfoHex ₂ Cer 40:2
glycochenodeoxycholic acid sulfate	Sul 41:1	SulfoHex ₂ Cer 40:1
hydroxyandrostenedione glucuronide	Sul 40:1 (OH)	SulfoHex ₂ Cer 41:1
11-oxo-androsterone glucuronide	Sul 40:0 (OH)	SulfoHex ₂ Cer 40:1 (OH)
hydroxyandrosterone glucuronide	Sul 42:3	SulfoHex ₂ Cer 42:3
taurolithocholic acid	Sul 42:2	SulfoHex ₂ Cer 42:2
sulfocholic acid	Sul 41:2 (OH)	SulfoHex ₂ Cer 42:1
pregnanediol glucuronide	Sul 42:1	SulfoHex ₂ Cer 41:1 (OH)
taurodeoxycholic acid	Sul 41:1 (OH)	SulfoHex ₂ Cer 40:0 (2OH)
sulfoglycolithocholic acid	Sul 41:0 (OH)	SulfoHex ₂ Cer 42:2 (OH)
taurocholic acid	Sul 40:0 (2OH)	SulfoHex ₂ Cer 42:1 (OH)
glycochenodeoxycholic acid sulfate	Sul 42:3 (OH)	SulfoHex ₂ Cer 41:0 (2OH)
aldosterone glucuronide	Sul 42:2 (OH)	SulfoHex ₂ Cer 42:0 (2OH)
tetrahydroaldosterone glucuronide	Sul 42:1 (OH)	
psychosine sulfate	Sul 42:0 (OH)	
deoxycholic acid glucuronide	Sul 41:0 (2OH)	
cholic acid glucuronide	Sul 43:2 (OH)	

glycochenodeoxycholic acid glucuronide	Sul 43:1 (OH)	
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Preferred sets of lipids for individual types of cancers are shown in the following tables.

Table 5. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for both genders and males (M) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing UHPSFC/MS).

S-plot	N-T all cancers both genders	N-T all cancers M	N-T breast cancer M	N-T kidney cancer M	N-T prostate cancer M
Up-regulated species in cancer	DG 34:0 MG 18:0 TG 49:0 MG 16:0 DG 36:0 TG 42:2 TG 44:0	DG 34:0 DG 36:0 TG 49:0 MG 18:0 TG 42:2 MG 16:0 TG 44:0	DG 34:0 DG 36:0 MG 16:0 MG 18:0 TG 50:0 TG 48:0 TG 51:1	DG 34:0 DG 36:0 MG 18:0 MG 16:0 TG 42:2 TG 49:0 Cer 42:3	TG 49:0 TG 42:2 DG 34:0 DG 36:0 TG 44:0 TG 56:1 TG 45:0
Down-regulated species in cancer	SM 42:1 SM 41:1 SM 41:2 SM 40:1 SM 38:1 SM 40:2 Cer42:1 LPC 18:2 SM 34:1 LPC 18:0	SM 42:1 SM 41:1 SM 40:1 LPC 18:2 SM 38:1 SM 41:2 SM 40:2 LPC 18:0 Cer42:1 SM 34:1	SM 42:1 LPC 18:2 LPC 18:0 LPC 18:1 LPC 16:0 SM 41:1 SM 40:1 SM 38:1 PC 32:2 SM 38:1 PC O-36:4	SM 42:1 SM 41:1 TG 58:6 LPC 18:2 SM 40:1 SM 38:1 SM 41:2 Cer 42:1 SM 40:2 TG 58:4	SM 42:1 SM 41:1 SM 40:1 LPC 18:2 LPC 18:0 SM 41:2 SM 40:2 SM 38:1 LPC 16:0 SM 42:2
No.: N/T	170/282	75/157	75/9	75/81	75/67
Sensitivity [%]	89.4	93.0	100	90.1	86.6
Specificity [%]	80.6	81.3	100	90.7	94.7

Table 6. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for females (F) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing UHPSFC/MS).

S-plot	N-T all cancers F	N-T breast cancer F	N-T kidney cancer F
Up-regulated species in cancer	MG 18:0 MG 16:0 DG 34:0 TG 49:0 TG 42:2	MG 18:0 MG 16:0 TG 49:0 DG 34:0 TG 42:2	MG 18:0 MG 16:0 DG 34:0 DG 36:0 -

	DG 36:0	TG 44:0	-
	-	TG 58:2	-
Down-regulated species in cancer	SM 42:1	SM 42:1	SM 42:1
	SM 41:1	PC 36:1	SM 41:1
	SM 41:2	SM 41:1	SM 41:2
	Cer 42:1	PC O-34:3	TG 56:1
	SM 40:1	SM 41:2	PC 32:2
	PC O-34:3	PC O-38:6	SM 40:1
	SM 38:1	PC O-36:3	Cer 42:1
	PC 36:1	SM 40:1	TG 47:1
	TG 55:5	Cer 42:1	TG 49:1
	SM 40:2	SM 38:1	TG 51:4
No.: N/T	95/125	95/94	95/31
Sensitivity [%]	88.0	87.2	74.2
Specificity [%]	87.4	93.7	100

Table 7. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing cancerous samples with each other (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing UHPSFC/MS).

S-plot	T-T 1/ kidney vs. 2/ prostate M	T-T 1/ breast vs. 2/ kidney M	T-T 1/ breast vs. 2/ kidney F
Up-regulated species in cancer 2	TG 56:1	SM 42:1	PC 36:1
	TG 50:0	LPC 18:2	TG 58:6
	TG 44:1	PC 32:2	PC O-38:6
	TG 44:0	LPC 18:1	PC O-38:5
	TG 46:0	LPC 18:0	Cer 42:3
	TG 44:2	PC O-38:6	PC O-36:5
	TG 46:1	LPC 16:0	Cer 40:1
	TG 45:0	PC O-36:3	PC 32:0
	TG 42:2	PC O-34:3	DG 36:2
	TG 47:0	PC 36:5	LPC 18:1
Up-regulated species in cancer 1	MG 18:0	TG 50:0	TG 49:0
	MG 16:0	TG 55:5	TG 56:1
	DG 36:0	TG 51:1	TG 44:1
	DG 34:0	TG 58:6	TG 45:0
	DG 36:3	TG 48:0	TG 45:1
	DG 34:2	TG 53:2	TG 44:2
	DG 32:0	TG 52:1	TG 46:2
	DG 32:1	TG 56:1	TG 44:0
	DG 36:2	TG 49:0	TG 47:1
	DG 34:1	TG 54:2	TG 46:1
No.: T/T	81/67	9/81	94/31
Sensitivity [%]	76.1	100	74.2
Specificity [%]	80.3	22.2	96.8

Table 8. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for both genders and males (M) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing MALDI-MS).

S-plot	N-T all cancers both genders	N-T all cancers M	N-T breast cancer M	N-T kidney cancer M	N-T prostate cancer M
Up-regulated	-	-	-	SulfoHex2Cer 42:2	-
Down-regulated species in cancer	Sul 34:0 (OH) SM 43:1 SM 39:1 Sul 41:1 (OH) Sul 40:1 SM 41:1 Sul 41:1 Sul 34:2 (OH) Sul 42:1 SM 33:1	SM 43:1 SM 39:1 Sul 41:1 (OH) Sul 40:1 Sul 34:0 (OH) Sul 40:1 (OH) SM 41:1 Sul 34:2 (OH) Sul 40:2 (OH) SM 32:1	Sul 40:1 Sul 41:1 (OH) Sul 34:0 (OH) Sul 42:1 Sul 40:1 (OH) Sul 42:1 (OH) Sul 40:2 (OH) Sul 34:2 (OH) Sul 41:1 Sul 42:3 (OH)	SM 43:1 Sul 41:1 (OH) SM 39:1 Sul 40:1 (OH) Sul 34:0 (OH) Sul 40:1 SM 41:1 Sul 42:1 (OH) SM 32:1 Sul 34:2 (OH)	Sul 34:0 (OH) Sul 40:1 SM 43:1 Sul 42:1 SM 39:1 SM 40:3 Sul 34:2 (OH) Sul 40:2 (OH) Sul 41:1 (OH) Sul 40:1 (OH)
No.: N/T	170/282	75/157	75/9	75/80	75/67
Sensitivity [%]	89.7	91.1	55.6	90.0	85.1
Specificity [%]	82.9	81.3	100	93.3	96.0

Table 9. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for females (F) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing MALDI-MS).

S-plot	N-T all cancers F	N-T breast cancer F	N-T kidney cancer F
Up-regulated	-	-	SulfoHex2Cer 42:2
Down-regulated species in cancer	Sul 34:0 (OH) Sul 41:1 (OH) SM 43:1 SM 39:1 Sul 41:1 Sul 40:1 Sul 42:1 SM 33:1 Sul 42:1 (2OH) Sul 34:2 (OH)	Sul 34:0 (OH) SM 39:1 Sul 41:1 (OH) SM 43:1 SM 33:1 Sul 42:1 Sul 40:1 Sul 41:1 SM 43:2 SM 32:1	Sul 41:1 (OH) Sul 34:0 (OH) SM 39:1 SM 43:1 Sul 40:1 (OH) Sul 42:1 (OH) Sul 42:1 (2OH) Sul 41:1 SM 41:1 Sul 40:1
No.: N/T	95/125	95/94	95/31
Sensitivity [%]	88.8	86.2	83.9

Specificity [%]	91.6	95.8	98.9
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Table 10. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for both genders and males (M) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons where results from MALDI and UHPSFC are combined).

S-plot	N-T all cancers both genders	N-T all cancers M	N-T breast cancer M	N-T kidney cancer M	N-T prostate cancer M
Up-regulated species in cancer	DG 34:0 MG 18:0 MG 16:0 DG 36:0 TG 49:0 TG 42:2 TG 44:0 -	DG 34:0 DG 36:0 MG 18:0 MG 16:0 TG 42:2 TG 49:0 SulfoHex2Cer 42:2 TG 44:0	DG 34:0 DG 36:0 MG 16:0 MG 18:0 TG 50:0 TG 48:0 TG 51:1 TG 55:5	DG 34:0 DG 36:0 MG 18:0 MG 16:0 SulfoHex2Cer 42:2 TG 49:0 TG 42:2 PI 38:6	TG 49:0 TG 42:2 TG 44:0 TG 56:1 DG 36:0 DG 34:0 TG 45:0 -
Down- regulated species in cancer	SM 42:1 SM 41:1 Sul 34:0 (OH) SM 41:2 SM 40:1 SM 43:1 SM 38:1 SM 40:2 SM 39:1 Sul 41:1 (OH)	SM 42:1 SM 41:1 SM 40:1 Sul 41:1 (OH) SM 43:1 LPC 18:2 Sul 40:1 SM 38:1 Sul 34:0 (OH) Sul 40:1 (OH)	SM 42:1 LPC 18:2 LPC 18:0 Sul 40:1 LPC 18:1 LPC 16:0 Sul 42:1 Sul 34:0 (OH) Sul 41:1 (OH) Sul 40:1 (OH)	SM 42:1 TG 58:6 SM 41:1 Sul 41:1 (OH) SM 40:1 SM 43:1 SM 38:1 Sul 40:1 (OH) SM 39:1 SM 41:2	SM 42:1 SM 41:1 SM 40:1 LPC 18:0 LPC 18:2 SM 38:1 SM 41:2 SM 40:2 Sul 34:0 (OH) Sul 40:1
No.: N/T	170/282	75/157	75/9	75/81	75/67
Sensitivity [%]	92.6	94.3	100	93.8	79.1
Specificity [%]	87.7	77.3	100	93.3	97.3

Table 11. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous samples with cancerous samples for females (F) and various cancer types (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons where results from MALDI and UHPSFC are combined).

S-plot	N-T all cancers F	N-T breast cancer F	N-T kidney cancer F
Up-regulated species in cancer	MG 18:0 MG 16:0 DG 34:0 TG 49:0	MG 18:0 MG 16:0 TG 49:0 DG 34:0	MG 18:0 MG 16:0 DG 34:0 DG 36:0

	TG 42:2 TG 44:0 DG 36:0 -	TG 42:2 TG 44:0 TG 58:2 TG 58:3	Cer 42:3 SulfoHex2Cer 42:2 - -
Down-regulated species in cancer	SM 42:1 SM 41:1 SM 41:2 SM 43:1 TG 55:5 SM 40:1 Cer 42:1 Sul 41:1 (OH) PC O-34:3 SM 39:1	SM 42:1 SM 41:1 SM 41:2 PC O-34:3 PC 36:1 SM 40:1 Sul 42:1 Sul 34:0 (OH) PC O-36:3 Sul 41:1 (OH)	SM 42:1 SM 41:1 Sul 41:1 (OH) SM 41:2 SM 39:1 Sul 42:1 (OH) Sul 40:1 (OH) TG 51:4 TG 49:2 PC 32:2
No.: N/T	95/125	95/94	95/31
Sensitivity [%]	89.6	91.5	83.9
Specificity [%]	90.5	94.7	100

Table 12. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing cancerous samples (cancer types) with each other (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons where results from MALDI and UHPSFC/MS are combined).

S-plot	T-T 1/ kidney vs. 2/ prostate M	T-T 1/ breast vs. 2/ kidney M	T-T 1/ breast vs. 2/ kidney F
Up-regulated species in cancer 2	TG 56:1 TG 50:0 TG 44:0 TG 45:0 TG 49:0 TG 46:0 TG 44:1 TG 47:0 TG 46:1 TG 44:2	SM 42:1 LPC 18:2 PC 32:2 Sul 42:1 Sul 40:1 LPC 18:1 LPC 18:0 Sul 40:2 Sul 42:1 (OH) Sul 42:2	PC 36:1 PC O-38:6 PC O-38:5 PC O-36:5 Cer 42:3 SM 36:0 TG 58:6 PC 32:0 Cer 40:1 DG 36:0
Up-regulated species in cancer 1	MG 18:0 MG 16:0 DG 36:0 DG 34:0 DG 36:3 SulfoHex2Cer 42:2 DG 34:2 Sul 42:3 LPC 16:0 DG 34:1	TG 55:5 TG 58:6 TG 53:2 TG 56:5 TG 51:1 TG 53:3 DG 34:0 TG 55:4 TG 54:2 TG 56:6	TG 49:0 TG 56:1 TG 48:4 TG 44:1 TG 50:5 TG 52:6 TG 48:3 TG 46:2 TG 50:4 TG 44:2
No.: T/T	81/67	9/81	94/31

Sensitivity [%]	91.0	100	77.4
Specificity [%]	82.7	22.2	97.9

Table 13. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous plasma samples with kidney cancerous plasma samples for males (M) and females (F) (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing shotgun MS).

S-plot	N-T kidney F	N-T kidney M
Up-regulated species in cancer	PE 42:9 SM 42:2 PC 38:4 MG 19:0 LPC O-16:0 TG 56:5 PS 32:2 SM 36:0 CE 16:0 LPC 18:0	LPC 16:0 SM 42:2 Hex2Cer 34:1 PS 42:1 PS 36:5 HexCer 42:2 CE 16:0 PC 34:1 PS 36:4 MG 18:0
Down-regulated species in cancer	CE 14:0 PC 32:2 SM 33:1 SM 32:1 PC 34:4 SM 39:1 SM 41:1 PC 34:3 HexCer 42:1 LPC 18:2	LPC 18:2 PE P-36:4 SM 39:1 PC 34:4 SM 41:2 PC O-36:5 PS 38:7 SM 41:1 TG 56:6 SM 40:2
No.:T/N	28/31	71/30
Sensitivity [%]	100	95.8
Specificity [%]	93.6	76.7

Table 14. Most up- and down-regulated species from S-plot of OPLS-DA model when comparing non-cancerous (N) urine samples with kidney and prostate cancerous (T) urine samples for both genders, males (M) and females (F) (N=non-tumor, T=tumor, data about sensitivity and specificity relate to a set of persons whose samples were measured employing MALDI-MS (absolute quantitation)).

S-plot	N-T both cancers (kidney, prostate) M	N-T prostate cancer M	N-T kidney cancer M
Up-regulated species in cancer	Sul 42:3 SulfoHex2Cer 40:2 SulfoHex2Cer 38:1 (OH) sulfocholic acid Sul 43:1 (2OH) SulfoHex2Cer 34:1 (OH)	Sul 42:3 SulfoHex2Cer 38:1 (OH) cortisol sulfate SulfoHex2Cer 34:1 (OH) Sul 43:1 (2OH) SulfoHex2Cer 40:2	SulfoHex2Cer 40:2 Sul 42:3 SulfoHex2Cer 38:1 sulfocholic acid SulfoHex2Cer 42:2 SulfoHex2Cer 38:1 (OH)

	Sul 42:3 (OH) SulfoHex2Cer 41:1 (OH) cortisol sulfate SulfoHex2Cer 38:1	SulfoHex2Cer 41:1 (OH) sulfocholic acid Sul 42:3 (OH) Sul 41:2	SulfoHex2Cer 34:1 SulfoHex2Cer 42:1 SulfoHex2Cer 34:1 (OH) Sul 43:1 (2OH)
Down-regulated species in cancer	Sul 38:1 (OH) Sul 34:1 (OH) SulfoHex2Cer 40:1 (OH) Sul 40:0 (2OH) Sul 40:1 (OH) SulfoHex2Cer 40:0 (2OH) Sul 41:0 (OH) Sul 41:1 Sul 41:0 (2OH) tauroolithocholic acid	hydroxypregnenolone sulfate Sul 38:1 (OH) Sul 40:2 SulfoHex2Cer 40:1 (OH) Sul 38:1 SulfoHex2Cer 40:0 (2OH) Sul 34:1 (OH) Sul 42:1 (2OH) Sul 40:1 (OH)	Sul 40:0 (2OH) Sul 41:0 (2OH) Sul 41:0 (OH) Sul 38:1 (OH) Sul 40:0 (OH) Sul 40:1 (OH) Sul 42:0 (2OH) Sul 42:1 (2OH) Sul 41:1 (OH) Sul 41:1
No.: N/T	34/137	34/67	34/72
Sensitivity [%]	93.5	91.0	91.7
Specificity [%]	58.8	76.5	76.5
S-plot	N-T kidney cancer both genders	N-T kidney cancer F	
Up-regulated species in cancer	SulfoHex2Cer 42:2 Sul 42:3 SulfoHex2Cer 40:2 SulfoHex2Cer 38:1 SulfoHex2Cer 42:1 cortisol sulfate SulfoHex2Cer 40:1 SulfoHex2Cer 34:1 SulfoHex2Cer 38:1 (OH) sulfocholic acid	Sul 42:3 SulfoHex2Cer 40:2 SulfoHex2Cer 42:2 SulfoHex2Cer 38:1 (OH) SulfoHex2Cer 42:1 Sul 43:1 (2OH) Sul 42:3 (OH) SulfoHex2Cer 40:1 Sul 42:2 SulfoHex2Cer 41:1 (OH)	
Down-regulated species in cancer	tauroolithocholic acid Sul 40:0 (2OH) Sul 41:0 (2OH) Sul 38:1 (OH) cholesterol sulfate Sul 41:0 (OH) Sul 40:0 (OH) SulfoHex2Cer 40:0 (2OH) Sul 42:0 (2OH) Sul 40:1 (OH)	tauroolithocholic acid taurocholic acid taurodeoxycholic acid sulfoglycolithocholic acid Sul 40:0 (2OH) Sul 34:1 (OH) Sul 41:0 (2OH) Sul 38:1 (OH) Sul 40:0 (OH) Sul 42:1 (2OH)	
No.: N/T	70/101	36/29	
Sensitivity [%]	87.1	86.2	
Specificity [%]	87.1	86.1	

For diagnosing pancreatic cancer, the lipidomic profile comprising at least 51, preferably at least 120, lipids is used in the present method. In one preferred embodiment, the lipids to be detected in order to

build a very reliable statistical model are preferably at least the sets shown in Table 15, or the sets listed in the Tables 28, 29, 30 or 31.

Table 15.

Set 1 (particularly suitable for shotgun MS)		Set 2 (particularly suitable for UHPSFC/MS)
CE 14:0	PE 32:0; PE O-33:0	CE 16:1
CE 16:0	PE 32:1; PE P-33:0	CE 16:0
CE 16:1	PE 34:0; PE P-36:6	CE 18:3
CE 18:1	PE 34:1; PE P-35:0	CE 18:2
CE 18:2	PE 34:2; PE P-35:1	CE 18:1
CE 18:3	PE 34:3; PE P-35:2	CE 20:5
CE 20:4	PE 36:0; PE P-38:6	CE 20:4
CE 20:5	PE 36:1; PE P-37:0	CE 20:3
CE 22:4	PE 36:2; PE P-37:1	CE 20:2
CE 22:5	PE 36:3; PE P-37:2	CE 22:6
CE 22:6	PE 36:4; PE P-37:3	Cer d42:2
Cer d18:0/16:1; Cer d18:0/15:2 (1OH)	PE 36:5; PE P-37:4	Cer d42:1
Cer d18:0/16:2	PE 38:0; PE P-40:6; PE O-39:0	DG 34:2
Cer d18:0/18:2	PE 38:1; PE P-40:7; PE P-39:0	DG 34:1
Cer d18:0/24:0; Cer d18:0/23:1 (1OH)	PE 38:2; PE P-40:8; PE P-39:1	DG 36:3
Cer d18:0/24:1; Cer d18:0/23:2 (1OH)	PE 38:3; PE P-40:9; PE P-39:2	DG 36:2
Cer d18:1/16:0; Cer d18:1/15:1 (1OH)	PE 38:4; PE P-40:10; PE P-29:3	DG 36:0
Cer d18:1/16:1; Cer d18:1/15:2 (1OH)	PE 38:5; PE P-39:4	DG 37:4
Cer d18:1/16:2	PE 38:6; PE P-39:5	Coenzyme Q10
Cer d18:1/18:0; Cer d18:1/17:1 (1OH)	PE 38:7; PE O-38:0; PE 37:0	MG 16:0
Cer d18:1/18:2	PE 40:1; PE P-42:7; PE P-41:0	MG 18:1
Cer d18:1/18:3	PE 40:2; PE P-42:8; PE P-41:1	MG 18:0
Cer d18:1/20:0; Cer d18:1/19:1 (1OH)	PE 40:3; PE P-42:9; PE P-41:2	PC O-32:1/P-32:0
Cer d18:1/22:0; Cer d18:1/21:1 (1OH)	PE 40:4; PE P-42:10; PE P-41:3	PC 32:2
Cer d18:1/23:0; Cer d18:1/22:1 (1OH)	PE 40:5; PE P-41:4	PC 32:1
Cer d18:1/24:0; Cer d18:1/23:1 (1OH)	PE 40:6; PE P-41:5	PC 32:0
Cer d18:1/24:1; Cer d18:1/23:2 (1OH)	PE 40:7; PE O-40:0; PE 39:0	PC O-34:3/P-34:2
Cer d18:1/25:0; Cer d18:1/24:1 (1OH)	PE 40:8; PE P-40:0; PE 39:1	PC 34:3
DG 30:0	PE 42:9; PE P-42:1; PE 41:2	PC 34:2
DG 31:0	PE P-34:0; PE 33:1	PC 34:1
DG 32:0	PE P-34:1; PE 33:2	PC O-36:5/P-36:4
DG 32:1	PE P-36:0; PE 35:1	PC O-36:4/P-36:3
DG 32:2	PE P-36:1; PE 35:2	PC O-36:3/P-36:2
DG 34:0	PE P-36:2; PE 35:3	PC 35:2
DG 34:1	PE P-36:3; PE 35:4	PC 35:1
DG 34:2	PE P-36:4; PE 35:5	PC 36:5
DG 34:3	PE P-38:2; PE 37:3	PC 36:4
DG 36:0	PE P-38:3; PE 37:4	PC 36:3
DG 36:1	PE P-38:4; PE 37:5	PC 36:2
DG 36:2	PE P-38:5; PE 37:6	PC 36:1
DG 36:3	PE P-40:4; PE 39:5	PC O-38:6/P-38:5
DG 36:4	PE P-40:5; PE 39:6	PC O-38:5/P-38:4
DG 38:2	PG 32:0; PG O-33:0	PC 37:3
DG 38:3	PG 32:1; PG P-33:0	PC 38:7
DG 38:4	PG 34:0; PG P-36:6	PC 38:6
DG 38:5	PG 34:1; PG P-35:0	PC 38:5

DG 38:6	PG 34:2; PG P-35:1	PC 38:4
Hex2Cer d18:1/16:0; Hex2Cer d18:1/15:1 (1OH)	PG 36:1; PG P-37:0	PC 38:3
Hex2Cer d18:1/20:0; Hex2Cer d18:1/19:1 (1OH)	PG 36:2; PG P-37:1	PC 38:2
Hex2Cer d18:1/21:0 (1OH)	PG 36:3; PG P-37:2	PC 40:6
Hex2Cer d18:1/22:0; Hex2Cer d18:1/21:1 (1OH)	PG 36:4; PG P-37:3	PC 40:5
Hex2Cer d18:1/24:1; Hex2Cer d18:1/23:2 (1OH)	PI 32:0; PI O-33:0	PC 40:4
HexCer d18:1/16:0; HexCer d18:1/15:1 (1OH)	PI 32:1; PI P-33:0	PC O-44:5/P-44:4
HexCer d18:1/20:0; HexCer d18:1/19:1 (1OH)	PI 34:0; PI P-36:6	SM d34:2
HexCer d18:1/22:0; HexCer d18:1/21:1 (1OH)	PI 34:1; PI P-35:0	SM d34:1
HexCer d18:1/24:0; HexCer d18:1/23:1 (1OH)	PI 34:2; PI P-35:1	SM d36:2
HexCer d18:1/24:1; HexCer d18:1/23:2 (1OH)	PI 36:0; PI P-38:6	SM d36:1
HexCer d18:1/25:0; HexCer d18:1/24:1 (1OH)	PI 36:1; PI P-37:0	SM d38:2
LPC 16:0	PI 36:2; PI P-37:1	SM d38:1
LPC 16:1	PI 36:3; PI P-37:2	SM d39:1
LPC 18:0	PI 36:4; PI P-37:3	SM d40:2
LPC 18:1	PI 38:2; PI P-40:8; PI P-39:1	SM d40:1
LPC 18:2	PI 38:3; PI P-40:9; PI P-39:2	SM d41:2
LPC 20:1	PI 38:4; PI P-40:10; PI P-29:3	SM d41:1
LPC 20:3	PI 38:5; PI P-39:4	SM d42:3
LPC 20:4	PI 38:6; PI P-39:5	SM d42:2
LPC 22:6	PI 40:0; PI P-42:6; PI O-41:0	SM d42:1
LPE 16:0	PI 40:4; PI P-42:10; PI P-41:3	TG 46:1
LPE 18:0	PI 40:5; PI P-41:4	TG 46:0
LPE 18:1	PI 40:6; PI P-41:5	TG 47:1
LPE 18:2	PI 42:3; PI P-43:2	TG 47:0
LPE 20:4	PI P-36:0; PI 35:1	TG 48:3
LPE 22:6	PI P-36:1; PI 35:2	TG 48:2
LPG 20:0	PI P-38:3; PI 37:4	TG 48:1
LPG O-18:0; LPG 17:0	PS 34:0; PS P-36:6	TG 48:0
LPG O-20:0; LPG 19:0	PS 34:2; PS P-35:1	TG 49:2
LPG O-22:0; LPG 21:0	PS 36:1; PS P-37:0	TG 49:1
MG 16:0	PS 38:4; PS P-40:10; PS P-29:3	TG 50:4
MG 17:0	PS 38:6; PS P-39:5	TG 50:3
MG 18:0	PS 42:1; PS P-43:0	TG 50:2
MG 18:1	PS P-32:0; PS-31:1	TG 50:1
MG 22:0	SM 32:1	TG 51:6
PC 30:0	SM 33:1	TG 51:5
PC 32:0; PC O-33:0	SM 34:0	TG 51:4
PC 32:1; PC P-33:0	SM 34:1	TG 51:3
PC 32:2; PC P-33:1	SM 34:2	TG 51:2
PC 34:1; PC P-35:0	SM 35:1	TG 51:1
PC 34:2; PC P-35:1	SM 36:0	TG 52:6
PC 34:3; PC P-35:2	SM 36:1	TG 52:5
PC 34:4; PC P-35:3	SM 36:2	TG 52:4

PC 36:0; PC P-38:6	SM 37:0	TG 52:3
PC 36:1; PC P-37:0	SM 39:1	TG 52:2
PC 36:2; PC P-37:1	SM 40:0	TG 52:1
PC 36:3; PC P-37:2	SM 40:1	TG 53:4
PC 36:4; PC P-37:3	SM 41:1	TG 53:3
PC 36:5; PC P-37:4	SM 41:2	TG 53:2
PC 38:2; PC P-40:8; PC P-39:1	SM 42:2	TG 53:1
PC 38:3; PC P-40:9; PC P-39:2	SM 43:1	TG 54:7
PC 38:4; PC P-40:10; PC P-29:3	SM 44:2	TG 54:6
PC 38:5; PC P-39:4	Sulfatide 41:0; Sulfatide 40:1 (1OH)	TG 54:5
PC 38:6; PC P-39:5	Sulfatide 41:1; Sulfatide 40:2 (1OH)	TG 54:4
PC 40:4; PC P-42:10; PC P-41:3	Sulfatide 43:0; Sulfatide 42:1 (1OH)	TG 54:3
PC 40:5; PC P-41:4	Sulfatide 43:1; Sulfatide 42:2 (1OH)	TG 54:2
PC 40:6; PC P-41:5	Sulfatide 43:2; Sulfatide 42:3 (1OH)	TG 55:6
PC O-32:0; PC-31:0	TG 56:3	TG 55:4
PC O-34:0; PC 33:0	TG 56:4	TG 55:3
PC P-32:0; PC-31:1	TG 56:5	TG 56:9
PC P-34:0; PC 33:1	TG 56:6	TG 56:8
PC P-34:1; PC 33:2	TG 58:6	TG 56:7
PC P-36:0; PC 35:1		TG 56:6
PC P-36:1; PC 35:2		TG 56:5
PC P-36:2; PC 35:3		TG 56:4
PC P-36:3; PC 35:4		TG 56:3
PC P-36:4; PC 35:5		TG 56:1
PC P-38:2; PC 37:3		TG 58:10
PC P-38:3; PC 37:4		TG 58:9
PC P-38:4; PC 37:5		TG 58:8
PC P-38:5; PC 37:6		TG 58:7
PC P-40:3; PC 39:4		TG 58:6
PC P-40:4; PC 39:5		TG 60:11
PC P-40:5; PC 39:6		TG 60:10
230		121

Brief description of Drawings

In the following descriptions, T1, T2, T3, T4, Tis, and Tx are stages of cancer (primary tumor) according to TNM classification. T1 is a very early stage of cancer, Tis means carcinoma insitu, and Tx means that tumour cannot be assessed.

Figure 1: PCA statistical model of 170 plasma samples of healthy controls (N), 282 plasma samples of patients suffering from cancer (T), 38 plasma samples of unknown classification (X) and quality control (Q) for both genders (generated from UHPSFC/MS data).

Figure 2: OPLS-DA statistical model of healthy control (N) and cancerous plasma samples (tumor stages T1, T2, T3, T4, Tis, and Tx) for both genders (generated from UHPSFC/MS data).

Figure 3: S-plot representing the most up and down regulated lipid species for comparison of non-cancerous and cancerous plasma samples.

Figure 4: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from breast, kidney, and prostate cancers (tumor stages T1, T2, T3, T4, and Tx) for males (generated from UHPSFC/MS data).

Figure 5: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from breast cancer (T) for males (generated from UHPSFC/MS data).

Figure 6: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from prostate cancer (tumor stages T2, T3, Tx) for males (generated from UHPSFC data).

Figure 7: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for males (generated from UHPSFC data).

Figure 8: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from breast and kidney cancer types (tumor stages T1, T2, T3, T4, and Tx) for females (generated from UHPSFC/MS data).

Figure 9: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from breast cancer (tumor stages T1, T2, Tis, and Tx) for females (generated from UHPSFC/MS data).

Figure 10: OPLS-DA statistical model of plasma samples of healthy controls (N) and patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for females (generated from UHPSFC data).

Figure 11: PCA statistical model of 170 samples of healthy controls (N), 111 samples of patients suffering from kidney cancer (T) and 24 samples of quality control pooled samples (Q) for both genders (generated from MALDI-MS data).

Figure 12: OPLS-DA statistical model of 170 samples of healthy controls (N), 111 samples of patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for both genders (generated from MALDI-MS data).

Figure 13: OPLS-DA analysis of 75 samples of healthy controls (N), 80 samples of patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for males (generated from MALDI-MS data).

Figure 14: OPLS-DA analysis of 95 samples of healthy controls (N), 32 samples of patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for females (generated from MALDI-MS data).

Figure 15: PCA analysis of 70 samples of healthy controls (N), 101 samples of patients suffering from kidney cancer (T) and 24 samples of quality control pooled samples (Q) for both genders (generated from MALDI-MS data).

Figure 16: OPLS-DA analysis of 70 samples of healthy controls (N), 101 samples of patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for both genders (generated from MALDI-MS data).

Figure 17: OPLS-DA analysis of 34 samples of healthy controls (N), 72 samples of patients suffering from kidney cancer (tumor stages T1, T2, T3, and Tx) for males (generated from MALDI-MS data).

Figure 18: OPLS-DA analysis of 36 samples of healthy controls (N), 29 samples of patients suffering

from kidney cancer (tumor stages T1, T2, T3, and Tx) for females (generated from MALDI-MS data).

Figure 19: OPLS-DA statistical model of breast, kidney, and prostate cancer plasma samples from males.

Figure 20: OPLS-DA plot statistical model for the differentiation of prostate and kidney cancer plasma samples from males.

5 Figure 21: OPLS-DA statistical model for the differentiation of breast and kidney cancer plasma samples from females.

Figure 22. OPLS-DA analysis of 79 samples of healthy controls (N), 213 samples of patients suffering from pancreatic cancer (tumor stages T1, T2, T3, T4, and Tx) for both genders (generated from UHPSFC/MS and shotgun data).

10 Figure 23. OPLS-DA analysis of 49 samples of healthy controls (N), 109 samples of patients suffering from pancreatic cancer (tumor stages T1, T2, T3, T4, and Tx) for males (generated from UHPSFC/MS and shotgun data).

Figure 24. OPLS-DA analysis of 30 samples of healthy controls (N), 104 samples of patients suffering from pancreatic cancer (tumor stages T1, T2, T3, T4, and Tx) for females (generated from UHPSFC/MS and shotgun data).

15 Figure 25. OPLS-DA statistical model prediction of being pancreatic cancer patient for females from UHPSFC/MS and shotgun data for unknown samples.

Figure 26. OPLS-DA statistical model prediction of being pancreatic cancer patient for males from UHPSFC/MS and shotgun data for unknown samples.

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Detailed description of the Invention

Sample collection:

Human body fluid samples of cancer patients and healthy volunteers are collected in the hospital, typically blood or urine. Other samples types are isolated from blood, such as plasma, serum, oncosomes, exosomes, extracellular vesicles, etc. The blood of human subjects is collected in the standard and well established way used in hospitals into anticoagulant-containing tubes, such as EDTA, heparin, citrate tubes, then serum or plasma is isolated using standardized protocols well known to a person skilled in the art, storage at -80°C at the clinic, transport from the clinic to the analytical laboratory using biological transport bags with dry ice (-20°C), storage again at -80°C until the analysis.

Preparation of a set of internal standards (mixture of internal standards):

Generally, an internal standard mixture is used for quantitation of lipid species. The internal standard for each lipid class behaves in the same way as the target compounds belonging to this lipid class. Due to the addition of the internal standard before sample processing, slight differences due to for instance pipetting errors can be compensated as the internal standard is affected in the same way as the target compounds.

In a particular embodiment, 2-4 mg of each standard is weighed into 2 mL HPLC glass vials using an analytical balance and dissolved in corresponding volume (chloroform : 2-propanol - 2:8) in order to obtain a final concentration of 2, 2.1, 1 or 0.25 µg/µL. Standards for each lipid class are mixed together to form internal standard mixtures as described in Table 16 for all herein shown types of MS analysis.

- 5 Preferably, one mixture of internal standards is prepared in a sufficient amount for the whole experiment, in order to avoid variances in quantitation due to slight differences in concentration of the internal standards when the mixture is prepared in several batches. Aliquots may be prepared of this internal standard mixture and stored at -80°C.

10 Table 16. Preparation of internal standards mixture.

Internal standards	MW	Stock concentration [µg/µL]	Volume [µL]	Concentration in plasma [nmol/mL]
CE d7 16:0	631.6285	2	200	443.3
Cer d18:1/12:0	481.4495	2	4	11.6
DG 12:1/12:1	452.3502	2	15	46.4
Hex2Cer d18:1/12:0	805.5551	2	4	7.0
HexCer d18:1/12:0	643.5023	2.1	3	6.9
Chol d7	393.6988	2	300	1066.8
PI 33:1 d7	846.596	1	16	13.2
LPC 17:0	509.3481	2.1	20	57.7
LPE 14:0	425.2542	2	4	13.2
LPG 14:0	478.2308	2.1	14	43.0
MG 19:1	370.3083	2	30	113.4
PA 14:0/14:0	614.3924	2	4	9.1
PC 14:0/14:0	677.4996	2	60	124.0
PE 14:0/14:0	635.4526	2	4	8.8
PG 14:0/14:0	688.4291	2	2	4.1
PS 14:0/14:0	701.4244	2	4	8.0
SM d18:1/12:0	646.505	2	20	43.3
SulfoHexCer d18:1/12:0	740.4857	0.25	0.28	0.1
TG 19:1/19:1/19:1	926.8302	2	75	113.3
PC 44:2	897.719	2	80	124.8
Solvent		CHCl ₃ :IPA 2:8	140.72	
Total Volume			1000	

Sample processing:

All samples are spiked before the extraction with the appropriate internal standard mixture (depending on which body fluid and which mass spectrometry method is used).

- 15 The lipidomic extractions were preferably performed by well-established procedures using chloroform – methanol – water extraction systems as published in our previous works [E. Cífková, M. Holčápek, M. Lída, D. Vrána, J. Gatěk, B. Melichar, Anal. Bioanal. Chem. 407 (2015) 991-1002; E. Cífková, M. Lída, R. Hrstka, D. Vrána, J. Gatěk, B. Melichar, M. Holčápek, Rapid Commun. Mass Spectrom. 31 (2017) 253-263]. The order of samples for extractions is randomized.

25 μ L of serum or plasma and 17.5 μ L of internal standard mixture and 2 mL chloroform (2x 1 mL) and 1 mL methanol are transferred into a glass vial (4 mL). Biological samples contain also proteins, which may lead to sticky and slimy samples. It must be ensured that the pipette draws the 25 μ L of serum or plasma and is not blocked with the slimy components during drawing. The glass vials are closed and put for 10 min into the ultrasonic bath at 40°C for homogenization. Afterwards, the samples are allowed to reach room temperature in order to ensure no evaporation of the organic solvents when opening the vials. 600 μ L of water are added to each sample. The samples are closed and vortexed for 1 min. It is important to do the extraction step always in the same way for all samples of one batch (one study). The target lipids for mass spectrometry are better soluble in the organic layer (bottom layer). Afterwards, the samples are centrifuged for 3 min at 3000 rpm in order to separate the organic and aqueous layer (in between these two layers a protein layer in the form of white precipitate is formed). The aqueous layer (upper layer) is removed via a glass pipette. The organic solvent containing the target compounds is evaporated under a stream of nitrogen at 30 °C and the glass vials containing the residue (target compounds) are stored at -80°C.

Before analysis, the samples are allowed to reach ambient temperature (so that they cannot draw water from the air when opening the vials) and then the residue from the extraction and evaporation (previous step) is dissolved in 500 μ L chloroform : 2-propanol (1:1, v/v). It is advisable to prepare enough solvent mixture of chloroform : 2-propanol (1:1, v/v) mixture for all samples to avoid variations between individual batches of the solvent mixture. The samples are vortexed carefully for 1 min to ensure that the target compounds are dissolved. The solution is filtered using a 0.2 μ m syringe filter in order to get rid of undissolved components, which may compromise the MS analysis. The vials are closed with PTFE caps and stored at -80°C.

For urine samples, reversed-phase solid phase extraction is performed. 2 mL of human urine together with 3 μ L of mixture of internal standards dissolved in methanol (SufoHexCer d18:1/12:0 of concentration 1.7 μ g/mL and D4 taurocholic acid of concentration 16.7 μ g/mL) are loaded on 200 mg tC18 cartridge (Sep-Pak Vac, 37-55 μ m particle size) (Waters, Milford, MA, USA) previously primed with 3 mL of methanol followed by 3 mL of water. Columns are washed with 3 mL of water, and studied lipids are further eluted with 3 mL of methanol. The eluates are collected, then evaporated by the gentle stream of nitrogen and redissolved in the mixture of 300 μ L of methanol before the measurement.

Sample preparation for UHPSFC/MS analysis

The filtrate is diluted 5 times or 20 times with a mixture of hexane : 2-propanol : chloroform 7:1.5:1.5 and transferred into an HPLC vial. The vials containing the diluted filtrate are closed with slit caps for analysis with UHPSFC/MS and placed in the autosampler.

Sample preparation for shotgun MS analysis

The filtrates are diluted 10 times depending on the samples by chloroform – methanol – 2-propanol (1:2:4, v/v/v) mixture containing 7.5 mmol/L of ammonium acetate and 1% of acetic acid.

Sample preparation for MALDI-MS analysis

- 5 MALDI matrix 9-aminoacridine (Sigma-Aldrich, St. Louis, MO, USA) is dissolved in methanol – water mixture (4:1, v/v) to provide the concentration of 5 mg/ml or 10 mg/ml and mixed with particular lipid extracts (1:1, v/v) – less preferably lipid extracts can be diluted with methanol (1:1, 1:2, or 1:3, v/v) before mixing with matrix. The deposited amount of extract/matrix mixture is 1 µl and the dried droplet crystallization is used for the sample deposition on the target plate. The deposition of small aliquot of
10 chloroform on MALDI plate spots before the application of diluted extract/matrix mixture is applied to avoid the drop spreading.

Mass spectrometry (MS) method development and validation

- Three major MS based methods for lipidomic quantitation were developed in particular, which are
15 described in more detail here. The method benefits from the use of pooled sample, which is a mixture of identical volumes of all samples for smaller studies with less than 100 subjects. In this study, the pooled sample is prepared from equal volumes of randomly selected cancer patients and healthy volunteers samples, keeping the ratio of males and females in the same proportion as in the sample set. The pooled sample is used for the method development and optimization. The pooled sample with added internal
20 standard mixture per each lipid class to be quantified is used for the full validation and QC during the measurements. The order of samples is always randomized in sample sequences to avoid measurements of non-cancerous and cancerous samples in certain portion of sequence.

- The system suitability test was carried out before the validation procedure at three concentration levels typically reported as low, medium and high concentration levels. All concentration levels must be within
25 the linear dynamic range. The low concentration level is close to the lower limit of quantitation (LLOQ), the middle concentration level is in the middle of the linear dynamic range, and the high concentration level is close to the upper limit of quantitation (ULOQ). In a particular embodiment, we use 5, 17.5, and 30 µl of IS mixture prepared according to Table 16 for low, medium and high concentration levels, respectively. Validation parameters such as selectivity, accuracy, precision, calibration curve, limits of
30 detection and quantitation, matrix effect, carry-over and stability were determined. Individual parameters were determined for IS representing properties of the lipid class. The selectivity was determined using 3 extracts of the pooled serum sample spiked before extraction with the IS mixture at low, middle and high concentration level and 3-6 extracts of appropriate non-spiked serum samples. The accuracy and precision were studied using the pooled serum sample spiked after the extraction at low, medium and high
35 concentration levels. The intra-day accuracy and intra-day precision were studied using three samples per concentration level. The inter-day accuracy and inter-day precision were evaluated among three independent runs on two different days using three samples at the low, medium and high concentration

level. The LLOQ and ULOQ corresponded to the first and the last points of linearity range, respectively. The limit of detection (LOD) was determined based on signal to noise ratio ($S/N = 3$) observed from reconstructed ion chromatogram or neutral loss (NL) and precursor ion (PI) mass spectra (shotgun MS) of internal standard mixture. The extraction recovery was determined by calculating the ratio of the signal response of samples spiked before and after extraction for low, medium and high concentration. The process efficiency was determined by calculating the ratio of the signal response of the spiked samples before extraction and the neat standard at different concentrations. The matrix effect was calculated from the ratio of the signal response of samples spiked after extraction and the neat standard. The carry-over was evaluated for each IS by the injection of blank sample with the pure solvent after the calibration sample at high concentration level (dilution factor of 10). The reliability of results obtained within analysis of large sample sets was evaluated by on-instrument and freeze-and-thaw stability tests. The stability of spiked plasma extract at middle concentration level was measured in autosampler at certain time intervals: 0, 4, 8, 12, 16, and 24 hours. Sample for freeze-and-thaw experiment was analyzed immediately after complete unassisted thawing in autosampler.

Table 17. Dilution scheme for calibration with pooled sample for UHPSFC/MS (volumes in μl) for plasma samples.

Mixture of IS	Pooled sample	Hexane : 2-propanol : chloroform (7:1.5:1.5, v/v/v)
150	100	250
100	100	300
50	100	350
20	100	380
15	100	385
10	100	390
5	100	395
3.5	100	396.5
2	100	398
IS mixture 1 : 50 diluted		
75	100	325
50	100	350
25	100	375
10	100	390
7.5	100	392.5
5	100	395
2.5	100	397.5
1	100	399

For calibration, the optimized mixture of IS for all methods in several dilutions were used in order to calibrate in the concentration ranges relevant for individual lipid classes. Depending on the dilution factor of the corresponding mass spectrometric method, the corresponding amounts of matrix were used. For

instance, UHPSFC/MS uses 1: 5 dilution of sample extracts. Therefore, 1/5 of blank plasma of a pooled sample were added (see Table 17 for more details).

UHPSFC/MS

- 5 Supercritical fluid chromatography is a tool for the separation of compounds of different polarity employing supercritical carbon dioxide (mobile phase) as main component for removing the compounds from an adsorbent (column-stationary phase). The addition of an organic solvent (typically methanol) to the supercritical carbon dioxide broadens the application range of UHPSFC and allows the removal of more polar compounds from the column. Generally, compounds can be differentiated if they are better
- 10 soluble in water or alcohols, than they are of polar nature or if they are better soluble for instance in hexane than they are of nonpolar nature. Depending on the nature of the stationary phase, the mobile phase and the target compounds, like polar or nonpolar, interactions can be forced. For instance, polar compounds prefer to interact with polar stationary phases and in order to remove those from the stationary phase, a polar mobile phase can be used to remove the compounds from the stationary phase. A
- 15 careful adjustment of these interactions by optimization of the mobile phase properties using a certain stationary phase allows the separation of compounds. The optimization of dimensions and properties of the stationary phase, such as smaller particle size and spherical particles of the sorbents, allows for a higher efficiency and is therefore called ultrahigh performance supercritical fluid chromatography (UHPSFC).
- 20 The chromatographic separation can be optimized for the separation of lipid classes, taking into account in particular the following. A lipid class has a dominant structural moiety (polar head group) in common which is mainly responsible for the interaction governing the retention mechanism. A lipid class can comprise numerous lipid species varying in the hydrocarbon chain length and structure (e.g., double bonds). Internal standards are added for each lipid (sub)class, therefore it is possible to identify and
- 25 quantify all lipid species within a particular lipid (sub)class by comparing it to the class internal standard. MS-Analysis: Using a high-resolution, accurate-mass spectrometer as a detector allows the identification and quantification of lipids, as each lipid species has a defined m/z value and gives a signal response depending on the concentration in the sample. In order to improve ionization and therefore the signal response of the target compounds, additives like acids and buffers are added to the sample or to the
- 30 mobile phase. In case of UHPSFC/MS, the use of a make-up solvent like acidified methanol further improves the sensitivity.

In one particular embodiment, a detailed description of all parameters applied for the UHPSFC/MS method to obtain the results presented herein below is as follows: Instrument - Acquity Ultra Performance Convergence Chromatography (UPC²) System hyphenated to the hybrid quadrupole-traveling wave ion

35 mobility- time of flight mass spectrometer Synapt G2 Si from Waters. Chromatographic settings - stationary phase: Acquity BEH UPC² column (100 × 3 mm, 1.7 μm, Waters), the flow rate was 1.9 mL/min, the injection volume 1 μL, the column temperature 60°C, the active back pressure regulator

(ABPR) was set to 1800 psi, gradient mode : CO₂ and methanol with 30 mM ammonium acetate and 1 % water. The gradient started at 1% modifier and increased to 51 % in 5 min, afterwards kept constant for 1 min and flushed back to starting conditions with a total run time of 7.5 min. injection needle wash: a mixture of hexane – 2-propanol- water (1:2:0.5, v/v) column wash after each biological sample injection: a blank was injected using a fast gradient: 0 min - 1%, 1.4 min - 51%, 1.6 min - 51%, 1.8 min - 1%, and 4.8 min - 1% modifier., make-up effluent: HPLC 515 pump (Waters) , make-up flow rate 0.25 mL/min methanol with 1 % water, and optionally 0.1% formic acid.

ESI – MS settings: a capillary voltage of 3 kV, a sampling cone of 20 V, the source offset of 90 V, a source temperature of 150 °C, a drying temperature of 500°C, the cone gas flow of 50 L h⁻¹, the drying gas flow of 1000 L h⁻¹ and the nebulizer gas of 4 bar. Resolution mode or sensitivity mode in positive ion mode and a mass range of m/z 50-1200. The scan time was 0.15 s, and measurements were performed in continuum mode. The peptide leucine enkephaline was used as the lock mass with a scan time of 0.1 s and interval of 30 s.

During the analysis, the samples in the sequence should be randomized so that not the same type of samples, such as only healthy (non-cancerous) samples, are measured in a row. This guarantees that in case of an error at a certain time not only one type of sample is affected. Furthermore, it is important to measure QC samples after a predetermined amount of samples in order to verify the instrument performance.

Before measuring biological samples, no injection, blank and QC samples are measured to check the instrument performance and afterwards it is continued with biological samples. All samples are measured in duplicates and after 20 samples or 40 + 40 injections (sample + wash) respectively, QC and blank samples are measured. During the whole study, measurement and sample preparation control is performed by evaluating the peak areas of each internal standard of each sample and exporting results in the Microsoft Excel file. The QC samples are aliquots of an extract of a mixture of serum or plasma samples.

The lock mass is continuously measured during analysis, however the lock mass correction is not applied online, as preliminary results showed that the mass accuracy is worse using online correction. Furthermore, continuum mode is applied so that it is possible to monitor the resolution of the instrument. After measurements, the raw data get noise reduced using the MassLynx software from Waters. This improves the mass spectra as well as significantly reduces the file size, which allows easier handling of the files for further processing. The files are further processed by applying the lock mass correction and converting the files from profile to centroid mode, which enhances the mass accuracy and further reduces the file size. (The file size is important for data processing. The processing software can only hardly deal with huge file sizes and sample numbers, resulting in continuous errors making the processing time-consuming and cumbersome.)

All investigations regarding measurement control, profile mode and offline lock mass correction as well as the noise reduction improved data quality.

Shotgun MS

Experiments as presented herein below were performed on a quadrupole-linear ion trap mass spectrometer 6500 QTRAP (Sciex, Concord, ON, Canada) equipped by ESI probe with the following setting of tuning parameters: the ionspray voltage 5200 V, the curtain gas 20 psi, the source temperature 50°C, the ion source gas(1) 15 psi, and the ion source gas(2) 10 psi. MS/MS scans are measured with the scan rate 1000 Da/s, the declustering potential 80 V, the entrance potential 10 V, and the collision energy specified in the Table 18. Samples are introduced by a flow injection using a liquid chromatograph Agilent 1290 Series (Agilent Technologies) consisted of Agilent 1290 binary pump and Agilent 1260 autosampler. 50 µL of sample was injected into the flow rate 3 µL/min of chloroform – methanol – 2-propanol (1:2:4, v/v/v) mixture containing 7.5 mmol/L of ammonium acetate and 1% of acetic acid with the analysis time 12 min, and the autosampler temperature 20°C. LC/MS system is washed after each analysis with methanol – 2-propanol – water (2:2:1, v/v/v) mixture containing 7.5 mmol/L of ammonium acetate and 1% of acetic acid. Measured data experiments are extracted using LipidView software with the mass tolerance 0.3 Da, the minimum $S/N = 5$ and the minimum intensity 1%. Raw data characterized by type of scans, m/z values and peak intensities are exported as *.txt* data and further processed using our Microsoft Excel macro script for the detection and quantitation of lipids. Lipid classes are characterized using type of scans, and individual lipid species in selected MS/MS scan are detected according to m/z values with the mass tolerance 0.3 Da based on the database compiled from identified lipids in the pooled sample followed by the isotopic correction of ion intensities. Concentration of lipid species are calculated from corrected ion intensity related to the intensity of lipid class internal standards.

Table 18. Characterization of shotgun MS/MS scans and their parameters for individual lipid classes. PI – precursor ion scan and NL – neutral loss scan.

Lipid class	Type of MS/MS scan	Collision energy	Observed ions
CE	PI 369; PI 376	12	$[M+NH_4]^+$
Cer	PI 264; PI 266	35	$[M+H]^+$
DG	NL 35	20	$[M+NH_4]^+$
Hex2Cer	PI 264; PI 266	35	$[M+H]^+$
HexCer	PI 264; PI 266	35	$[M+H]^+$
Cholesterol	PI 369; PI 376	12	$[M+NH_4]^+$
LPA	NL 115	25	$[M+NH_4]^+$
LPC	PI 184	35	$[M+H]^+$
LPE	NL 141	30	$[M+H]^+$
LPG	NL 189	30	$[M+NH_4]^+$
LPS	NL 185	30	$[M+H]^+$
MG	NL 35	20	$[M+NH_4]^+$
PA	NL 115	25	$[M+NH_4]^+$
PC	PI 184	35	$[M+H]^+$
PE	NL 141	30	$[M+H]^+$
PG	NL 189	30	$[M+NH_4]^+$
PS	NL 185	30	$[M+H]^+$

SM	PI 184	35	[M+H] ⁺
SulfoHexCer	NL 98	25	[M+H] ⁺
TG	NL 17	30	[M+NH ₄] ⁺

MALDI mass spectrometry

Mass spectra were measured using ultrahigh-resolution MALDI mass spectrometer LTQ Orbitrap XL (Thermo Fisher Scientific, Waltham, MA, USA) equipped with the nitrogen UV laser (337 nm, 60 Hz) with a beam diameter of about 80 μm x 100 μm . The LTQ Orbitrap instrument is operated in the negative-ion mode over a normal mass range m/z 400 - 2000 and the mass resolution is set to $R = 100,000$ (full width at half maximum definition, at m/z 400). The zig-zag (or spiral outwards) sample movement with 250 μm step size is used during the individual data acquisition. The laser energy corresponds to 15% of maximum and 2 microscans/scan with 2 laser shots per microscan at 36 different positions are accumulated for each measurement to achieve a reproducible signal. Each sample (spotted matrix and body fluid extract mixture) is spotted five times. The total acquisition time of one sample including five consecutive spots is around ten minutes. Each measurement is represented by one average MALDI-MS spectrum with thousands of m/z values. The automatic peak assignment is subsequently performed and particular m/z peaks are matched with deprotonated molecules from a database created during the identification procedure using the Excel macro script. This peak assignment results in the generation of the list of present m/z of studied lipids with the average intensities in particular spectra for each samples that is used for further statistical evaluation.

Data processing and quantitation

The data processing starts with the data export from MS vendor software (e.g., Waters, Sciex or Thermo Scientific) into a data-processing software which may be Microsoft Excel for further steps to be done semi-automatically using e.g. advanced Excel script, in particular isotopic correction (Tables 19 and 20) and zero-filling. Quality control (QC) samples should be regularly injected to check the right and constant response of mass spectrometer. The typical QC sample is a pooled sample containing internal standards for all lipid classes to be quantified, which is injected after every 20 injections, and responses of individual internal standards are plotted versus the time. If responses of the internal standards are reduced too much, then it is the indication of an instrumental problem, typically the mass spectrometer requires cleaning due to the injection of too many samples. The typical cleaning interval is about several hundreds of samples, but it may strongly depend on the quality of prepared sample extracts, geometry of ion source, and system configuration.

The following example describes the example of UHPSFC/MS measurement on Synapt G2Si instrument from Waters, but similar approach is also applicable for other MS methods and different MS platforms from any instrumental vendor. The noise reduced, lock mass corrected and converted files are further processed with the MarkerLynx software. The reduced sequence table only including serum or plasma samples and QC samples has to be prepared in MassLynx with the corresponding suffix in the sample name (sample_nr20_AFAMM). Then the time scan range for each lipid class over the whole sequence

has to be determined (for example m/z 250-350 is used for CE). For each lipid class, the method is created in MarkerLynx with the corresponding scan range, which will be combined, the mass peak separation of 50 mDa and marker intensity threshold of 3000. The method for each lipid class is applied for the sequence and MarkerLynx table with m/z values against the combined intensities is created. This table is exported into a text file and imported into a homemade database for the identification and quantitation of lipid species using Microsoft Excel. The m/z values obtained from MarkerLynx are compared to the accurate m/z values deposited as database for hundreds of lipid species for the identification. The database was created by evaluating present species in tissue and plasma samples. The identified lipid species are isotopically corrected and quantified by calculating the concentration in relation to the intensity and concentration of the (sub)class IS obtaining the table of lipid species concentrations vs. individual samples. Zero-filling procedure is performed. The average of the multiple injected samples for individual lipid species is calculated. The final data matrix, where the columns are individual subjects and lines are individual lipids, are used for further MDA statistical evaluation for absolute quantification. For relative quantification, the concentration of individual species within a class is related to the sum of concentrations of this lipid class in one sample. The resulting table is then used for statistical evaluation equally as for the absolute quantification.

Table 19. Database of lipid species monitored during the identification step in the positive-ion mode together with the calculation of isotopic correction for M+1 and M+2 isotopic peaks (so called deisotoping).

Lipid	m/z	Isotopic correction	
		M+2	M+1
CE 16:0 D7 (IS)	376.3955	0.00%	0.00%
CE 10:0	558.5244	0.00%	0.00%
CE 12:0	586.5557	0.00%	0.00%
CE 14:1	612.5714	0.00%	0.00%
CE 14:0	614.5870	10.59%	0.00%
CE 15:1	626.5532	0.00%	0.00%
CE 15:0	628.6027	11.09%	0.00%
CE 16:1	640.6027	0.00%	0.00%
CE 16:0	642.6184	11.61%	0.00%
CE 16:0 D7 (IS)	649.6623	0.00%	0.00%
CE 17:1	654.6183	0.00%	0.00%
CE 17:0	656.6340	12.14%	0.00%
CE 18:4	662.5870	0.00%	0.00%
CE 18:3	664.6027	12.64%	0.00%
CE 18:2	666.6184	12.65%	0.00%
CE 18:1	668.6340	12.67%	0.00%
CE 18:0	670.6497	12.68%	0.00%
CE 19:1	682.6497	0.00%	0.00%
CE 19:0	684.6653	13.23%	0.00%
CE 20:5	688.6027	0.00%	0.00%
CE 20:4	690.6184	13.75%	0.00%
CE 20:3	692.6340	13.76%	0.00%
CE 20:2	694.6497	13.77%	0.00%
CE 20:1	696.6653	13.78%	0.00%
CE 20:0	698.6810	13.80%	0.00%
CE 21:1	710.6809	0.00%	0.00%

CE 21:0	712.6966	14.37%	0.00%
CE 22:6	714.6184	14.39%	0.00%
CE 22:5	716.6340	14.90%	0.00%
CE 22:4	718.6496	14.91%	0.00%
CE 22:3	720.6653	14.93%	0.00%
CE22:2	722.6810	14.94%	0.00%
CE 22:1	724.6966	14.95%	0.00%
CE 22:0	726.7123	14.96%	0.00%
CE 23:1	738.7122	0.00%	0.00%
CE 23:0	740.7279	15.57%	0.00%
CE 24:5	744.6653	0.00%	0.00%
CE 24:4	746.6809	16.13%	0.00%
CE 24:3	748.6966	16.14%	0.00%
CE 24:2	750.7122	16.15%	0.00%
CE 24:1	752.7279	0.00%	0.00%
CE 24:0	754.7436	16.18%	0.00%
CE 25:0	768.7592	0.00%	0.00%
CE 26:5	772.6966	0.00%	0.00%
CE 26:4	774.7122	17.39%	0.00%
CE 26:3	776.7279	17.40%	0.00%
CE 26:0	782.7748	0.00%	0.00%
CE 27:0	796.7905	0.00%	0.00%
CE 28:0	810.8061	0.00%	0.00%
TG 35:0	642.5667	0.00%	0.00%
TG 36:1	654.5667	0.00%	0.00%
TG 36:0	656.5823	10.53%	0.00%
TG 38:3	678.5667	0.00%	0.00%
TG 38:2	680.5823	11.49%	0.00%
TG 38:1	682.5980	11.50%	0.00%
TG 38:0	684.6136	11.51%	0.00%
TG 40:4	704.5823	0.00%	0.00%
TG 40:3	706.5980	12.50%	0.00%
TG 40:2	708.6136	12.51%	0.00%
TG 40:1	710.6293	12.52%	0.00%
TG 40:0	712.6449	12.54%	0.00%
TG 41:1	724.6449	0.00%	0.00%
TG 41:0	726.6606	13.07%	0.00%
TG 42:4	732.6136	0.00%	0.00%
TG 42:3	734.6293	0.00%	0.00%
TG 42:2	736.6449	13.59%	0.00%
TG 42:1	738.6606	13.60%	0.00%
TG 42:0	740.6763	13.61%	0.00%
TG 43:1	752.6763	0.00%	0.00%
TG 43:0	754.6919	14.17%	0.00%
TG 44:4	760.6449	0.00%	0.00%
TG 44:3	762.6606	0.00%	0.00%
TG 44:2	764.6763	14.71%	0.00%
TG 44:1	766.6919	14.72%	0.00%
TG 44:0	768.7076	14.73%	0.00%
TG O-46:5/P-46:4	772.6813	0.00%	0.00%
TG O-46:4/P-46:3	774.6970	15.64%	0.00%
TG 45:3	776.6762	0.00%	0.00%
TG 45:2	778.6919	15.29%	0.00%
TG 45:1	780.7076	15.30%	0.00%
TG 45:0	782.7232	15.31%	0.00%
TG 46:4	788.6763	0.00%	0.00%
TG 46:3	790.6919	15.87%	0.00%
TG 46:2	792.7076	15.58%	0.00%
TG 46:1	794.7232	15.89%	0.00%
TG 46:0	796.7389	15.91%	0.00%
TG 47:3	804.7076	0.00%	0.00%

TG 47:2	806.7232	16.48%	0.00%
TG 47:1	808.7389	16.50%	0.00%
TG 47:0	810.7545	16.51%	0.00%
TG 48:5	814.6919	0.00%	0.00%
TG 48:4	816.7076	0.00%	0.00%
TG 48:3	818.7232	17.09%	0.00%
TG 48:2	820.7389	17.10%	0.00%
TG 48:1	822.7545	17.11%	0.00%
TG 48:0	824.7702	17.13%	0.00%
TG 49:3	832.7389	0.00%	0.00%
TG 49:2	834.7545	17.73%	0.00%
TG 49:1	836.7702	17.74%	0.00%
TG 49:0	838.7858	17.76%	0.00%
TG 50:6	840.7076	18.32%	0.00%
TG 50:5	842.7232	18.33%	0.00%
TG 50:4	844.7389	18.34%	0.00%
TG 50:3	846.7545	18.36%	0.00%
TG 50:2	848.7702	18.37%	0.00%
TG 50:1	850.7858	18.38%	0.00%
TG 50:0	852.8015	18.40%	0.00%
TG 51:6	854.7232	18.41%	0.00%
TG 51:5	856.7389	18.98%	0.00%
TG 51:4	858.7545	18.99%	0.00%
TG 51:3	860.7702	19.01%	0.00%
TG 51:2	862.7858	19.02%	0.00%
TG 51:1; TG 52:8	864.8015	19.04%	0.00%
TG 52:7	866.7232	0.00%	0.00%
TG 51:0	866.8171	19.04%	0.00%
TG 52:6	868.7389	19.06%	0.00%
TG 52:5	870.7545	19.65%	0.00%
TG 52:4	872.7702	19.66%	0.00%
TG 52:3	874.7858	19.67%	0.00%
TG 52:2	876.8015	19.69%	0.00%
TG 52:1	878.8171	19.70%	0.00%
TG 52:0	880.8328	19.72%	0.00%
TG 53:6	882.7545	19.73%	0.00%
TG 53:5	884.7702	20.32%	0.00%
TG 53:4	886.7858	20.34%	0.00%
TG 53:3; TG 54:10	888.8015	20.35%	0.00%
TG 53:2; TG 54:9	890.8171	20.36%	0.00%
TG 54:8	892.7388	0.00%	0.00%
TG 53:1	892.8327	20.38%	0.00%
TG 54:7	894.7545	20.98%	0.00%
TG 53:0	894.8484	20.39%	0.00%
TG 54:6	896.7702	20.41%	0.00%
TG 54:5	898.7858	21.01%	0.00%
TG 54:4	900.8015	21.02%	0.00%
TG 54:3	902.8171	21.04%	0.00%
TG 54:2	904.8328	21.05%	0.00%
TG 54:1	906.8484	21.07%	0.00%
TG 54:0	908.8641	21.08%	0.00%
TG 55:6	910.7858	21.10%	0.00%
TG 55:5	912.8015	21.71%	0.00%
TG 55:4	914.8171	21.73%	0.00%
TG 55:3; TG 56:10	916.8328	21.74%	0.00%
TG 56:9	918.7545	0.00%	0.00%
TG 55:2	918.8484	21.75%	0.00%
TG 56:8	920.7701	22.38%	0.00%
TG 55:1	920.8640	21.76%	0.00%
TG 56:7	922.7858	22.39%	0.00%
TG 55:0; TG 56:7	922.8797	21.79%	0.00%

TG 56:6	924.8015	21.80%	0.00%
TG 56:5	926.8171	22.42%	0.00%
TG 56:4	928.8328	22.44%	0.00%
TG 56:3	930.8484	22.45%	0.00%
TG 56:2	932.8641	22.47%	0.00%
TG 56:1	934.8797	22.48%	0.00%
TG 57:7	936.8014	0.00%	0.00%
TG 56:0	936.8954	22.50%	0.00%
TG 57:6	938.8171	22.51%	0.00%
TG 58:12	940.7388	0.00%	0.00%
TG 57:5	940.8328	23.15%	0.00%
TG 58:11	942.7545	23.79%	0.00%
TG 57:4	942.8484	23.16%	0.00%
TG 58:10	944.7701	23.81%	0.00%
TG 57:3 (IS)	944.8640	23.18%	0.00%
TG 58:9	946.7858	23.82%	0.00%
TG 57:2	946.8797	23.20%	0.00%
TG 58:8	948.8014	23.84%	0.00%
TG 57:1; TG 58:8	948.8954	23.21%	0.00%
TG 58:7	950.8171	23.86%	0.00%
TG 57:0; TG 58:7	950.9110	23.23%	0.00%
TG 58:6	952.8328	23.24%	0.00%
TG 58:5	954.8484	23.89%	0.00%
TG 58:4	956.8641	23.90%	0.00%
TG 58:3	958.8797	23.92%	0.00%
TG 58:2	960.8954	23.93%	0.00%
TG 59:8	962.8171	0.00%	0.00%
TG 58:1	962.9110	23.95%	0.00%
TG 59:7	964.8327	24.60%	0.00%
TG 58:0	964.9267	23.96%	0.00%
TG 60:13	966.7545	0.00%	0.00%
TG 59:6	966.8484	23.98%	0.00%
TG 60:12	968.7701	25.29%	0.00%
TG 59:5	968.8641	24.64%	0.00%
TG 60:11	970.7858	25.30%	0.00%
TG 59:4	970.8797	24.65%	0.00%
TG 60:10	972.8014	25.32%	0.00%
TG 59:3	972.8953	24.67%	0.00%
TG 60:9	974.8171	25.33%	0.00%
TG 59:2	974.9110	24.68%	0.00%
TG 60:8	976.8327	25.35%	0.00%
TG 59:1	976.9266	24.70%	0.00%
TG 59:1; TG 60:8	976.9267	24.70%	0.00%
TG 60:7	978.8484	25.37%	0.00%
TG 59:0; TG 60:7	978.9423	24.72%	0.00%
TG 60:6	980.8641	24.73%	0.00%
TG 60:5	982.8797	25.40%	0.00%
TG 60:4	984.8954	25.41%	0.00%
TG 60:3	986.9110	25.43%	0.00%
TG 60:2	988.9267	25.45%	0.00%
TG 60:1	990.9423	25.46%	0.00%
TG 60:0	992.9580	25.48%	0.00%
TG 62:12	996.8014	0.00%	0.00%
TG 62:11	998.8171	26.86%	0.00%
TG 61:4	998.9110	0.00%	0.00%
TG 62:10	1000.8327	26.88%	0.00%
TG 61:3	1000.9266	26.20%	0.00%
TG 62:9	1002.8484	26.89%	0.00%
TG 61:2	1002.9423	26.22%	0.00%
TG 62:8	1004.8640	26.91%	0.00%
TG 62:7	1006.8797	26.92%	0.00%

TG 62:6	1008.8953	26.94%	0.00%
TG 62:5	1010.9110	26.96%	0.00%
TG 62:4	1012.9266	26.97%	0.00%
TG 62:3	1014.9423	26.99%	0.00%
TG 62:2	1016.9579	27.01%	0.00%
TG 62:1	1018.9736	27.02%	0.00%
TG 64:12	1024.8327	0.00%	0.00%
TG 64:11	1026.8484	28.46%	0.00%
TG 63:4	1026.9423	0.00%	0.00%
TG 64:10	1028.8640	28.48%	0.00%
TG 63:3	1028.9579	27.79%	0.00%
TG 64:9	1030.8797	28.50%	0.00%
TG 64:8	1032.8953	28.52%	0.00%
TG 64:7	1034.9110	28.53%	0.00%
TG 64:6	1036.9266	28.55%	0.00%
TG 64:5	1038.9423	28.57%	0.00%
TG 64:4	1040.9579	28.58%	0.00%
TG 66:12	1052.8640	0.00%	0.00%
TG 66:11	1054.8797	30.12%	0.00%
TG 66:10	1056.8953	30.14%	0.00%
TG 66:9	1058.9110	30.15%	0.00%
TG 66:8	1060.9266	30.17%	0.00%
TG 66:7	1062.9423	30.19%	0.00%
TG 66:6	1064.9579	30.21%	0.00%
MG 10:0	264.2169	0.00%	0.00%
MG 12:0	292.2482	0.00%	0.00%
MG 14:1	318.2639	0.00%	0.00%
MG 14:0	320.2795	2.59%	0.00%
MG 15:1	332.2795	0.00%	0.00%
MG 15:0	334.2952	2.80%	0.00%
MG 16:1	346.2952	0.00%	0.00%
MG 16:0	348.3108	3.03%	0.00%
MG 16:0	353.2662	0.00%	0.00%
MG 17:1	360.3108	0.00%	0.00%
MG 17:0	362.3265	3.27%	0.00%
MG 17:0	367.2819	0.00%	0.00%
MG 18:4	368.2795	0.00%	0.00%
Chol	369.3516	0.00%	0.00%
Chol D7 (IS)	376.3955	0.00%	0.00%
Chol	404.3887	0.00%	0.00%
Chol D7 (IS)	411.4326	0.00%	0.00%
MG 18:3	370.2952	3.50%	0.00%
MG 18:2	372.3108	3.51%	0.00%
MG 18:1	374.3265	3.51%	0.00%
MG 18:0	376.3421	3.52%	0.00%
MG 18:1	379.2819	0.00%	0.00%
MG 18:0	381.2975	3.42%	0.00%
MG 19:1 (IS)	388.3421	0.00%	0.00%
MG 19:0	390.3578	3.78%	0.00%
MG 19:1 (IS)	393.2975	0.00%	0.00%
MG 20:5	394.2952	0.00%	0.00%
MG 20:4	396.3108	4.03%	0.00%
MG 20:3	398.3265	4.04%	0.00%
MG 20:2	400.3421	4.04%	0.00%
MG 20:1	402.3578	4.05%	0.00%
MG 21:1	416.3734	0.00%	0.00%
MG 21:0	418.3891	4.34%	0.00%
MG 22:6	420.3108	4.35%	0.00%
MG 22:5	422.3265	4.61%	0.00%
MG 22:4	424.3421	4.61%	0.00%
MG 22:3	426.3587	4.62%	0.00%

MG22:2	428.3734	4.63%	0.00%
MG 22:1	430.3891	4.63%	0.00%
MG 22:0	432.4047	4.64%	0.00%
DG 24:2 (IS)	435.3469	0.00%	0.00%
MG 23:1	444.4047	0.00%	0.00%
MG 23:0	446.4204	4.95%	0.00%
MG 24:1	458.4204	0.00%	0.00%
MG 24:0	460.4360	5.27%	0.00%
DG 24:2 (IS)	470.3840	0.00%	0.00%
DG 28:0	530.4779	0.00%	0.00%
DG 29:0	544.4935	0.00%	0.00%
DG 30:2	554.4779	0.00%	0.00%
DG 30:1	556.4935	7.67%	0.00%
DG 30:0	558.5092	7.68%	0.00%
DG 31:2	568.4935	0.00%	0.00%
DG 31:1	570.5092	8.08%	0.00%
DG 31:0	572.5248	8.09%	0.00%
DG 32:3	580.4936	0.00%	0.00%
DG 32:2	582.5092	8.50%	0.00%
DG 32:1	584.5249	8.50%	0.00%
DG 32:0	586.5405	8.51%	0.00%
DG 33:3	594.5092	0.00%	0.00%
DG 33:2	596.5248	8.93%	0.00%
DG 33:1	598.5405	8.94%	0.00%
DG 33:0	600.5561	8.95%	0.00%
DG 34:4	606.5092	0.00%	0.00%
DG 34:3	608.5249	9.36%	0.00%
DG 34:2	610.5405	9.37%	0.00%
DG 34:1	612.5562	9.38%	0.00%
DG 34:0	614.5718	9.39%	0.00%
DG 35:4	620.5248	0.00%	0.00%
DG 35:3	622.5405	9.82%	0.00%
DG 35:2	624.5561	9.83%	0.00%
DG 35:1	626.5718	9.84%	0.00%
DG 35:0	628.5875	9.85%	0.00%
DG 36:5	632.5249	0.00%	0.00%
DG 36:4	634.5405	10.28%	0.00%
DG 36:3	636.5561	10.29%	0.00%
DG 36:2	638.5718	10.30%	0.00%
DG 36:1	640.5874	10.31%	0.00%
DG 37:7	642.5092	0.00%	0.00%
DG 36:0	642.6031	10.32%	0.00%
DG 37:5	646.5405	0.00%	0.00%
DG 37:4	648.5561	0.00%	0.00%
DG 37:3	650.5718	10.77%	0.00%
DG 37:2	652.5874	10.78%	0.00%
DG 37:1	654.6031	10.79%	0.00%
DG 38:7	656.5248	0.00%	0.00%
DG 37:0	656.6188	10.80%	0.00%
DG 38:6	658.5405	11.23%	0.00%
DG 38:5	660.5561	11.24%	0.00%
DG 38:4	662.5718	11.26%	0.00%
DG 38:3	664.5874	11.27%	0.00%
DG 38:2	666.6031	11.28%	0.00%
DG 38:1	668.6187	11.29%	0.00%
DG 38:0	670.6344	11.30%	0.00%
DG 39:6	672.5562	11.31%	0.00%
DG 39:5	674.5718	11.75%	0.00%
DG 39:4	676.5875	11.76%	0.00%
DG 40:10; DG 39:3	678.5092	11.77%	0.00%
DG 40:9; DG 39:2	680.5249	12.223%	0.000%

DG 40:8; DG 39:1	682.5405	12.23%	0.00%
DG 40:7; DG 39:0	684.5562	12.25%	0.00%
DG 40:6	686.5718	12.26%	0.00%
DG 40:5	688.5874	12.27%	0.00%
DG 40:4	690.6031	12.28%	0.00%
DG 40:3	692.6187	12.29%	0.00%
DG 40:2	694.6344	12.30%	0.00%
DG 40:1	696.6500	12.31%	0.00%
DG 40:0	698.6657	12.32%	0.00%
DG 41:6	700.5675	12.33%	0.00%
DG 41:5	702.3603	12.80%	0.00%
DG 41:4	704.6188	12.81%	0.00%
DG 42:10; DG 41:3	706.5405	12.82%	0.00%
DG 42:9; DG 41:2	708.5562	13.29%	0.00%
DG 42:8; DG 41:1	710.5718	13.30%	0.00%
DG 42:7; DG 41:0	712.5875	13.32%	0.00%
DG 42:6	714.6031	13.33%	0.00%
DG 42:5	716.6188	13.34%	0.00%
DG 42:4	718.6344	13.35%	0.00%
DG 42:3	720.6501	13.36%	0.00%
DG 42:2	722.6657	13.37%	0.00%
DG 42:1	724.6814	13.39%	0.00%
DG 42:0	726.6970	13.40%	0.00%
DG 44:0	754.7283	0.00%	0.00%
Coenzyme Q10	880.7177	0.00%	0.00%
Cer d30:1 (IS)	464.4462	0.00%	0.00%
Cer d18:1/12:2	478.4255	0.00%	0.00%
Cer d18:1/12:1	480.4411	6.08%	0.00%
Cer d18:0/12:2	480.4412	0.00%	0.00%
Cer d18:1/12:0 (IS)	482.4568	6.08%	0.00%
Cer d18:0/12:1 (IS)	482.4568	6.08%	0.00%
Cer d18:0/12:0	484.4725	6.09%	0.00%
Cer d18:1/13:2	492.4411	0.00%	0.00%
Cer d32:1	492.4775	0.00%	0.00%
Cer d18:1/13:1; Cer d18:1/12:2 (1OH)	494.4568	6.45%	0.00%
Cer d18:0/13:2	494.4568	0.00%	0.00%
Cer d18:1/13:0; Cer d18:1/12:1 (1OH)	496.4724	6.46%	0.00%
Cer d18:0/13:1; Cer d18:0/12:2 (1OH)	496.4725	6.46%	0.00%
Cer d18:1/12:0 (1OH)	498.4517	6.46%	0.00%
Cer d18:0/13:0; Cer d18:0/12:1 (1OH)	498.4881	6.46%	0.00%
Cer d18:0/12:0 (1OH)	500.4674	6.47%	0.00%
Cer d18:1/14:2	506.4568	0.00%	0.00%
Cer d18:1/14:1; Cer d18:1/13:2 (1OH)	508.4724	6.83%	0.00%
Cer d18:0/14:2	508.4725	0.00%	0.00%
Cer d18:1/14:0; Cer d18:1/13:0 (1OH)	510.4808	6.84%	0.00%
Cer d18:0/14:1; Cer d18:0/13:2 (1OH)	510.4881	6.84%	0.00%
Cer d18:1/13:0 (1OH)	512.4674	6.85%	0.00%
Cer d18:0/14:0; Cer d18:0/13:0 (1OH)	512.4965	6.85%	0.00%
Cer d18:0/13:0 (1OH)	514.4831	6.86%	0.00%
Cer d34:2	518.4932	0.00%	0.00%
Cer d18:1/15:2	520.4724	0.00%	0.00%
Cer d34:1	520.5088	7.41%	0.00%
Cer d18:0/15:2	522.4881	0.00%	0.00%
Cer d18:1/15:1; Cer d18:1/14:2 (1OH)	522.4881	7.23%	0.00%
Cer d34:0	522.5245	7.42%	0.00%
Cer d18:1/15:0; Cer d18:1/14:1 (1OH)	524.5037	7.24%	0.00%
Cer d18:0/15:1; Cer d18:0/14:2 (1OH)	524.5038	7.24%	0.00%
Cer d18:1/14:0 (1OH)	526.4830	7.24%	0.00%
Cer d18:0/15:0; Cer d18:0/14:1 (1OH)	526.5194	7.24%	0.00%
Cer d18:0/14:0 (1OH)	528.4987	7.25%	0.00%
Cer d18:1/16:2	534.4881	0.00%	0.00%

Cer d35:1	534.5245	0.00%	0.00%
Cer d18:1/16:1; Cer d18:1/15:2 (1OH)	536.5037	7.63%	0.00%
Cer d18:0/16:2	536.5038	0.00%	0.00%
Cer d18:0/16:1; Cer d18:0/15:2 (1OH)	538.5194	7.64%	0.00%
Cer d18:1/16:0; Cer d18:1/15:1 (1OH)	538.5194	7.64%	0.00%
Cer d18:1/15:0 (1OH)	540.4987	7.65%	0.00%
Cer d18:0/16:0; Cer d18:0/15:1 (1OH)	540.5351	7.65%	0.00%
Cer d18:0/15:0 (1OH)	542.5144	7.66%	0.00%
Cer d36:2	546.5245	0.00%	0.00%
Cer d18:1/17:2	548.5037	0.00%	0.00%
Cer d36:1	548.5401	8.27%	0.00%
Cer d18:0/17:2	550.5194	0.00%	0.00%
Cer d18:1/17:1; Cer d18:1/16:2 (1OH)	550.5194	8.05%	0.00%
Cer d36:0	550.5558	8.28%	0.00%
Cer d18:1/17:0; Cer d18:1/16:1 (1OH)	552.5350	8.06%	0.00%
Cer d18:0/17:1; Cer d18:0/16:2 (1OH)	552.5351	8.06%	0.00%
Cer d18:1/16:0 (1OH)	554.5143	8.07%	0.00%
Cer d18:0/17:0; Cer d18:0/16:1 (1OH)	554.5507	8.07%	0.00%
Cer d18:0/16:0 (1OH)	556.5300	8.08%	0.00%
Cer d18:1/18:3	560.5037	0.00%	0.00%
Cer d18:1/18:2	562.5193	8.48%	0.00%
Cer d37:1	562.5558	0.00%	0.00%
Cer d18:0/18:2	564.5350	0.00%	0.00%
Cer d18:1/18:1; Cer d18:1/17:2 (1OH)	564.5350	8.49%	0.00%
Cer d18:1/18:0; Cer d18:1/17:1 (1OH)	566.5506	8.50%	0.00%
Cer d18:0/18:1; Cer d18:0/17:2 (1OH)	566.5507	8.50%	0.00%
Cer d18:1/17:0 (1OH)	568.5300	8.51%	0.00%
Cer d18:0/18:0; Cer d18:0/17:1 (1OH)	568.5663	8.51%	0.00%
Cer d18:0/17:0 (1OH)	570.5457	8.51%	0.00%
Cer d38:2	574.5558	0.00%	0.00%
Cer d18:1/19:2	576.5349	0.00%	0.00%
Cer d38:1	576.5714	9.17%	0.00%
Cer d18:0/19:2	578.5506	0.00%	0.00%
Cer d18:1/19:1; Cer d18:1/18:2 (1OH)	578.5506	8.93%	0.00%
Cer d38:0	578.5871	9.18%	0.00%
Cer d18:1/19:0; Cer d18:1/18:1 (1OH)	580.5662	8.94%	0.00%
Cer d18:0/19:1; Cer d18:0/18:2 (1OH)	580.5663	8.94%	0.00%
Cer d18:1/18:0 (1OH)	582.5383	8.95%	0.00%
Cer d18:0/19:0; Cer d18:0/18:1 (1OH)	582.5819	8.95%	0.00%
Cer d18:0/18:0 (1OH)	584.5540	8.96%	0.00%
Cer d18:1/20:2	590.5506	0.00%	0.00%
Cer d39:1	590.5871	0.00%	0.00%
Cer d18:1/20:1; Cer d18:1/19:2 (1OH)	592.5662	9.39%	0.00%
Cer d18:0/20:2	592.5663	0.00%	0.00%
Cer d18:0/20:1; Cer d18:0/19:2 (1OH)	594.5819	9.40%	0.00%
Cer d18:1/20:0; Cer d18:1/19:1 (1OH)	594.5819	9.40%	0.00%
Cer d18:1/19:0 (1OH)	596.5613	9.41%	0.00%
Cer d18:0/20:0; Cer d18:0/19:1 (1OH)	596.5976	9.41%	0.00%
Cer d18:0/19:0 (1OH)	598.5770	9.42%	0.00%
Cer d40:2	602.5871	0.00%	0.00%
Cer d18:1/21:2	604.5662	0.00%	0.00%
Cer d40:1	604.6027	10.11%	0.00%
Cer d18:0/21:2	606.5819	0.00%	0.00%
Cer d18:1/21:1; Cer d18:1/20:2 (1OH)	606.5819	9.86%	0.00%
Cer d40:0	606.6184	10.13%	0.00%
Cer d18:1/21:0; Cer d18:1/20:1 (1OH)	608.5975	9.87%	0.00%
Cer d18:0/21:1; Cer d18:0/20:2 (1OH)	608.5976	9.87%	0.00%
Cer d18:1/20:0 (OH)	610.5769	9.88%	0.00%
Cer d18:0/21:0; Cer d18:0/20:1 (1OH)	610.6132	9.88%	0.00%
Cer d18:0/20:0 (1OH)	612.5926	9.89%	0.00%
Cer d18:1/22:2	618.5818	0.00%	0.00%

Cer d41:1	618.6184	0.00%	0.00%
Cer d18:0/22:2	620.5975	0.00%	0.00%
Cer d18:1/22:1; Cer d18:1/21:2 (1OH)	620.5975	10.34%	0.00%
Cer d41:0	620.6340	10.62%	0.00%
Cer d18:1/22:0; Cer d18:1/21:1 (1OH)	622.6131	10.35%	0.00%
Cer d18:0/22:1; Cer d18:0/21:2 (1OH)	622.6132	10.35%	0.00%
Cer d18:1/21:0 (1OH)	624.5926	10.36%	0.00%
Cer d18:0/22:0; Cer d18:0/21:1 (1OH)	624.6288	10.36%	0.00%
Cer d18:0/21:0 (1OH)	626.6083	10.37%	0.00%
Cer d42:3	628.6027	0.00%	0.00%
Cer d42:2	630.6184	11.10%	0.00%
Cer d18:1/23:2	632.5974	0.00%	0.00%
Cer d42:1	632.6340	11.11%	0.00%
Cer d18:0/23:2	634.6131	0.00%	0.00%
Cer d18:1/23:1; Cer d18:1/22:2 (1OH)	634.6131	10.83%	0.00%
Cer d42:0	634.6497	11.12%	0.00%
Cer d18:1/23:0; Cer d18:1/22:1 (1OH)	636.6287	10.84%	0.00%
Cer d18:0/23:1; Cer d18:0/22:2 (1OH)	636.6288	10.84%	0.00%
Cer d18:1/22:0 (1OH)	638.6082	10.85%	0.00%
Cer d18:0/23:0; Cer d18:0/22:1 (1OH)	638.6444	10.85%	0.00%
HexCer d18:1/12:2	640.4784	10.86%	0.00%
Cer d18:0/22:0 (1OH)	640.6239	10.86%	0.00%
HexCer d18:1/12:1	642.4940	9.58%	0.00%
HexCer d18:0/12:2	642.4941	10.87%	0.00%
HexCer d18:1/12:0 (IS)	644.5097	9.59%	0.00%
HexCer d18:0/12:1 (IS)	644.5097	9.59%	0.00%
Cer d43:2	644.6340	0.00%	0.00%
HexCer d18:0/12:0	646.5254	9.60%	0.00%
Cer d18:1/24:2	646.6131	9.60%	0.00%
Cer d43:1	646.6497	11.63%	0.00%
Cer d18:1/24:1; Cer d18:1/23:2 (1OH)	648.6287	11.34%	0.00%
Cer d18:0/24:2	648.6288	9.61%	0.00%
Cer d43:0	648.6653	11.64%	0.00%
Cer d18:0/24:1; Cer d18:0/23:2 (1OH)	650.6444	11.35%	0.00%
Cer d18:1/24:0; Cer d18:1/23:1 (1OH)	650.6444	11.35%	0.00%
Cer d18:1/23:0 (1OH)	652.6239	11.36%	0.00%
Cer d18:0/24:0; Cer d18:0/23:1 (1OH)	652.6601	11.36%	0.00%
HexCer d18:1/13:2	654.4940	11.07%	0.00%
Cer d18:0/23:0 (1OH)	654.6396	11.07%	0.00%
HexCer d18:1/13:1; HexCer d18:1/12:2 (1OH)	656.5097	10.03%	0.00%
HexCer d18:0/13:2	656.5097	11.08%	0.00%
Cer d44:3	656.6340	0.00%	0.00%
HexCer d18:1/13:0; HexCer d18:1/12:1 (1OH)	658.5253	10.04%	0.00%
HexCer d18:0/13:1; HexCer d18:0/12:2 (1OH)	658.5254	10.04%	0.00%
Cer d44:2	658.6497	12.15%	0.00%
HexCer d18:1/12:0 (1OH); Cer d18:1/25:2	660.5046	10.05%	0.00%
HexCer d18:0/13:0; HexCer d18:0/12:1 (1OH)	660.5410	10.05%	0.00%
Cer d44:1	660.6653	12.16%	0.00%
HexCer d18:0/12:0 (1OH); Cer d18:0/25:2	662.5203	10.06%	0.00%
Cer d18:1/25:1; Cer d18:1/24:2 (1OH)	662.6444	10.06%	0.00%
Cer d44:0	662.6810	12.17%	0.00%
Cer d18:1/25:0; Cer d18:1/24:1 (1OH)	664.6600	11.86%	0.00%
Cer d18:0/25:1; Cer d18:0/24:2 (1OH)	664.6601	11.86%	0.00%
Cer d18:1/24:0 (1OH)	666.6395	11.88%	0.00%
Cer d18:0/25:0; Cer d18:0/24:1 (1OH)	666.6757	11.88%	0.00%
HexCer d18:1/14:2	668.5097	11.58%	0.00%
Cer d18:0/24:0 (1OH)	668.6552	11.89%	0.00%
HexCer d18:1/14:1; HexCer d18:1/13:2 (1OH)	670.5253	10.49%	0.00%
HexCer d18:0/14:2	670.5254	11.59%	0.00%
HexCer d18:1/14:0; HexCer d18:1/13:0 (1OH)	672.5337	10.50%	0.00%
HexCer d18:0/14:1; HexCer d18:0/13:2 (1OH)	672.5410	10.50%	0.00%

HexCer d18:0/14:0; HexCer d18:0/13:0 (1OH)	674.5494	10.51%	0.00%
Cer d18:1/26:2; HexCer d18:1/13:0 (1OH)	674.6443	10.51%	0.00%
Cer d18:0/26:2; HexCer d18:0/13:0 (1OH)	676.6600	10.52%	0.00%
Cer d18:1/26:1; Cer d18:1/25:2 (1OH)	676.6600	12.38%	0.00%
Cer d18:1/26:0; Cer d18:1/25:1 (1OH)	678.6756	12.39%	0.00%
Cer d18:0/26:1; Cer d18:0/25:2 (1OH)	678.6757	12.39%	0.00%
Cer d18:1/25:0 (1OH)	680.6552	12.41%	0.00%
Cer d18:0/26:0; Cer d18:0/25:1 (1OH)	680.6913	12.41%	0.00%
HexCer d18:1/15:2	682.5253	12.11%	0.00%
Cer d18:0/25:0 (1OH)	682.6709	12.42%	0.00%
HexCer d18:0/15:2	684.5410	12.11%	0.00%
HexCer d18:1/15:1; HexCer d18:1/14:2 (1OH)	684.5410	10.96%	0.00%
HexCer d18:1/15:0; HexCer d18:1/14:1 (1OH)	686.5566	10.97%	0.00%
HexCer d18:0/15:1; HexCer d18:0/14:2 (1OH)	686.5567	10.97%	0.00%
HexCer d18:1/14:0 (1OH); Cer d18:1/27:2	688.5359	10.98%	0.00%
HexCer d18:0/15:0; HexCer d18:0/14:1 (1OH)	688.5723	10.98%	0.00%
HexCer d18:0/14:0 (1OH); Cer d18:0/27:2	690.5516	10.99%	0.00%
Cer d18:1/27:1; Cer d18:1/26:2 (1OH)	690.6756	10.90%	0.00%
Cer d18:1/27:0; Cer d18:1/26:1 (1OH)	692.6912	12.94%	0.00%
Cer d18:0/27:1; Cer d18:0/26:2 (1OH)	692.6913	11.00%	0.00%
Cer d18:1/26:0 (1OH)	694.6708	12.95%	0.00%
Cer d18:0/27:0; Cer d18:0/26:1 (1OH)	694.7069	12.95%	0.00%
HexCer d18:1/16:2	696.5410	12.63%	0.00%
Cer d18:0/26:0 (1OH)	696.6865	12.96%	0.00%
HexCer d18:1/16:1; HexCer d18:1/15:2 (1OH)	698.5566	11.44%	0.00%
HexCer d18:0/16:2	698.5567	12.64%	0.00%
HexCer d18:0/16:1; HexCer d18:0/15:2 (1OH)	700.5723	11.45%	0.00%
HexCer d18:1/16:0; HexCer d18:1/15:1 (1OH)	700.5723	11.45%	0.00%
HexCer d18:0/16:0; HexCer d18:0/15:1 (1OH)	702.5880	11.46%	0.00%
Cer d18:1/28:2; HexCer d18:1/15:0 (1OH)	702.6756	11.46%	0.00%
Cer d18:1/28:1; Cer d18:1/27:2 (1OH)	704.6912	13.48%	0.00%
Cer d18:0/28:2; HexCer d18:0/15:0 (1OH)	704.6913	11.47%	0.00%
Cer d18:0/28:1; Cer d18:0/27:2 (1OH)	706.7069	13.49%	0.00%
Cer d18:1/28:0; Cer d18:1/27:1 (1OH)	706.7069	13.49%	0.00%
Cer d18:1/27:0 (1OH)	708.6865	13.50%	0.00%
Cer d18:0/28:0; Cer d18:0/27:1 (1OH)	708.7226	13.50%	0.00%
HexCer d18:1/17:2	710.5566	13.17%	0.00%
Cer d18:0/27:0 (1OH)	710.7022	13.51%	0.00%
HexCer d18:0/17:2	712.5723	13.18%	0.00%
HexCer d18:1/17:1; HexCer d18:1/16:2 (1OH)	712.5723	11.93%	0.00%
HexCer d18:1/17:0; HexCer d18:1/16:1 (1OH)	714.5879	11.95%	0.00%
HexCer d18:0/17:1; HexCer d18:0/16:2 (1OH)	714.5880	11.95%	0.00%
HexCer d18:1/16:0 (1OH)	716.5672	11.96%	0.00%
HexCer d18:0/17:0; HexCer d18:0/16:1 (1OH)	716.6036	11.96%	0.00%
HexCer d18:0/16:0 (1OH)	718.5829	11.97%	0.00%
Cer d18:1/29:1; Cer d18:1/28:2 (1OH)	718.7069	11.97%	0.00%
Cer d18:1/29:0; Cer d18:1/28:1 (1OH)	720.7225	14.06%	0.00%
Cer d18:0/29:1; Cer d18:0/28:2 (1OH)	720.7226	11.98%	0.00%
Cer d18:1/28:0 (1OH)	722.7201	14.07%	0.00%
Cer d18:0/29:0; Cer d18:0/28:1 (1OH)	722.7382	14.07%	0.00%
HexCer d18:1/18:2	724.5722	13.73%	0.00%
Cer d18:0/28:0 (1OH)	724.7358	14.08%	0.00%
HexCer d18:0/18:2	726.5879	13.74%	0.00%
HexCer d18:1/18:1; HexCer d18:1/17:2 (1OH)	726.5879	12.44%	0.00%
HexCer d18:1/18:0; HexCer d18:1/17:1 (1OH)	728.6035	12.45%	0.00%
HexCer d18:0/18:1; HexCer d18:0/17:2 (1OH)	728.6036	12.45%	0.00%
HexCer d18:1/17:0 (1OH)	730.5829	12.46%	0.00%
HexCer d18:0/18:0; HexCer d18:0/17:1 (1OH)	730.6192	12.46%	0.00%
HexCer d18:0/17:0 (1OH)	732.5986	12.47%	0.00%
Cer d18:1/30:1; Cer d18:1/29:2 (1OH)	732.7228	12.47%	0.00%
Cer d18:1/30:0; Cer d18:1/29:1 (1OH)	734.7381	14.64%	0.00%

Cer d18:0/30:1; Cer d18:0/29:2 (1OH)	734.7385	12.49%	0.00%
Cer d18:1/29:0 (1OH)	736.7178	14.65%	0.00%
Cer d18:0/30:0; Cer d18:0/29:1 (1OH)	736.7538	14.65%	0.00%
HexCer d18:1/19:2	738.5878	14.29%	0.00%
Cer d18:0/29:0 (1OH)	738.7335	14.66%	0.00%
HexCer d18:0/19:2	740.6035	14.31%	0.00%
HexCer d18:1/19:1; HexCer d18:1/18:2 (1OH)	740.6035	12.96%	0.00%
HexCer d18:1/19:0; HexCer d18:1/18:1 (1OH)	742.6191	12.97%	0.00%
HexCer d18:0/19:1; HexCer d18:0/18:2 (1OH)	742.6192	12.97%	0.00%
HexCer d18:1/18:0 (1OH)	744.5912	12.98%	0.00%
HexCer d18:0/19:0; HexCer d18:0/18:1 (1OH)	744.6348	12.98%	0.00%
HexCer d18:0/18:0 (1OH)	746.6069	12.99%	0.00%
HexCer d18:1/20:2	752.6035	12.99%	0.00%
HexCer d18:1/20:1; HexCer d18:1/19:2 (1OH)	754.6191	13.49%	0.00%
HexCer d18:0/20:2	754.6192	13.01%	0.00%
HexCer d18:0/20:1; HexCer d18:0/19:2 (1OH)	756.6348	13.50%	0.00%
HexCer d18:1/20:0; HexCer d18:1/19:1 (1OH)	756.6348	13.50%	0.00%
HexCer d18:1/19:0 (1OH)	758.6142	13.52%	0.00%
HexCer d18:0/20:0; HexCer d18:0/19:1 (1OH)	758.6505	13.52%	0.00%
HexCer d18:0/19:0 (1OH)	760.6299	13.53%	0.00%
HexCer d18:1/21:2	766.6191	0.00%	0.00%
HexCer d18:0/21:2	768.6348	0.00%	0.00%
HexCer d18:1/21:1; HexCer d18:1/20:2 (1OH)	768.6348	14.04%	0.00%
HexCer d18:1/21:0; HexCer d18:1/20:1 (1OH)	770.6504	14.05%	0.00%
HexCer d18:0/21:1; HexCer d18:0/20:2 (1OH)	770.6505	14.05%	0.00%
HexCer d18:1/20:0 (OH)	772.6298	14.06%	0.00%
HexCer d18:0/21:0; HexCer d18:0/20:1 (1OH)	772.6661	14.06%	0.00%
HexCer d18:0/20:0 (OH)	774.6455	14.07%	0.00%
HexCer d18:1/22:2	780.6347	0.00%	0.00%
HexCer d18:0/22:2	782.6504	0.00%	0.00%
HexCer d18:1/22:1; HexCer d18:1/21:2 (1OH)	782.6504	14.59%	0.00%
HexCer d18:1/22:0; HexCer d18:1/21:1 (1OH)	784.6660	14.60%	0.00%
HexCer d18:0/22:1; HexCer d18:0/21:2 (1OH)	784.6661	14.60%	0.00%
HexCer d18:1/21:0 (1OH)	786.6455	14.62%	0.00%
HexCer d18:0/22:0; HexCer d18:0/21:1 (1OH)	786.6817	14.62%	0.00%
HexCer d18:0/21:0 (1OH)	788.6612	14.63%	0.00%
HexCer d18:1/23:2	794.6503	0.00%	0.00%
HexCer d18:0/23:2	796.6660	0.00%	0.00%
HexCer d18:1/23:1; HexCer d18:1/22:2 (1OH)	796.6660	15.16%	0.00%
HexCer d18:1/23:0; HexCer d18:1/22:1 (1OH)	798.6816	15.17%	0.00%
HexCer d18:0/23:1; HexCer d18:0/22:2 (1OH)	798.6817	15.17%	0.00%
HexCer d18:1/22:0 (1OH)	800.6611	15.18%	0.00%
HexCer d18:0/23:0; HexCer d18:0/22:1 (1OH)	800.6973	15.18%	0.00%
Hex2Cer d18:1/12:2	802.5314	14.84%	0.00%
HexCer d18:0/22:0 (1OH)	802.6768	15.20%	0.00%
Hex2Cer d18:1/12:1	804.5470	13.55%	0.00%
Hex2Cer d18:0/12:2	804.5471	14.85%	0.00%
Hex2Cer d18:0/12:1 (IS)	806.5627	13.56%	0.00%
Hex2Cer d18:1/12:0 (IS)	806.5627	13.56%	0.00%
Hex2Cer d18:0/12:0	808.5784	13.57%	0.00%
HexCer d18:1/24:2	808.6660	13.57%	0.00%
HexCer d18:1/24:1; HexCer d18:1/23:2 (1OH)	810.6816	15.74%	0.00%
HexCer d18:0/24:2	810.6817	13.58%	0.00%
HexCer d18:0/24:1; HexCer d18:0/23:2 (1OH)	812.6973	15.75%	0.00%
HexCer d18:1/24:0; HexCer d18:1/23:1 (1OH)	812.6973	15.75%	0.00%
HexCer d18:1/23:0 (1OH)	814.6768	15.77%	0.00%
HexCer d18:0/24:0; HexCer d18:0/23:1 (1OH)	814.7130	15.77%	0.00%
Hex2Cer d18:1/13:2	816.5470	15.41%	0.00%
HexCer d18:0/23:0 (1OH)	816.6925	15.78%	0.00%
Hex2Cer d18:0/13:2	818.5627	15.42%	0.00%
Hex2Cer d18:1/13:1; Hex2Cer d18:1/12:2 (1OH)	818.5627	14.07%	0.00%

Hex2Cer d18:1/13:0; Hex2Cer d18:1/12:1 (1OH)	820.5783	14.08%	0.00%
Hex2Cer d18:0/13:1; Hex2Cer d18:0/12:2 (1OH)	820.5784	14.08%	0.00%
Hex2Cer d18:1/12:0 (1OH); HexCer d18:1/25:2	822.5576	14.09%	0.00%
Hex2Cer d18:0/13:0; Hex2Cer d18:0/12:1 (1OH)	822.5940	14.09%	0.00%
Hex2Cer d18:0/12:0 (1OH); HexCer d18:0/25:2	824.5733	14.10%	0.00%
HexCer d18:1/25:1; HexCer d18:1/24:2 (1OH)	824.6973	13.79%	0.00%
HexCer d18:1/25:0; HexCer d18:1/24:1 (1OH)	826.7129	16.35%	0.00%
HexCer d18:0/25:1; HexCer d18:0/24:2 (1OH)	826.7130	13.80%	0.00%
HexCer d18:1/24:0 (1OH)	828.6924	16.36%	0.00%
HexCer d18:0/25:0; HexCer d18:0/24:1 (1OH)	828.7286	16.36%	0.00%
Hex2Cer d18:1/14:2	830.5627	15.99%	0.00%
HexCer d18:0/24:0 (1OH)	830.7081	16.37%	0.00%
Hex2Cer d18:1/14:1; Hex2Cer d18:1/13:2 (1OH)	832.5783	14.60%	0.00%
Hex2Cer d18:0/14:2	832.5784	16.00%	0.00%
Hex2Cer d18:1/14:0; Hex2Cer d18:1/13:1 (1OH)	834.5867	14.61%	0.00%
Hex2Cer d18:0/14:1; Hex2Cer d18:0/13:2 (1OH)	834.5940	14.61%	0.00%
Hex2Cer d18:0/14:0; Hex2Cer d18:0/13:1 (1OH)	836.6024	14.63%	0.00%
HexCer d18:1/26:2; Hex2Cer d18:1/13:0 (1OH)	836.6972	14.63%	0.00%
HexCer d18:0/26:2; Hex2Cer d18:0/13:0 (1OH)	838.7129	14.64%	0.00%
HexCer d18:1/26:1; HexCer d18:1/25:2 (1OH)	838.7129	16.94%	0.00%
HexCer d18:1/26:0; HexCer d18:1/25:1 (1OH)	840.7285	16.95%	0.00%
HexCer d18:0/26:1; HexCer d18:0/25:2 (1OH)	840.7286	16.95%	0.00%
HexCer d18:1/25:0 (1OH)	842.7081	16.96%	0.00%
HexCer d18:0/26:0; HexCer d18:0/25:1 (1OH)	842.7442	16.96%	0.00%
Hex2Cer d18:1/15:2	844.5783	16.59%	0.00%
HexCer d18:0/25:0 (1OH)	844.7238	16.98%	0.00%
Hex2Cer d18:0/15:2	846.5940	16.60%	0.00%
Hex2Cer d18:1/15:1; Hex2Cer d18:1/14:2 (1OH)	846.5940	15.15%	0.00%
Hex2Cer d18:1/15:0; Hex2Cer d18:1/14:1 (1OH)	848.6096	15.16%	0.00%
Hex2Cer d18:0/15:1; Hex2Cer d18:0/14:2 (1OH)	848.6097	15.16%	0.00%
Hex2Cer d18:1/14:0 (1OH); HexCer d18:1/27:2	850.5889	15.17%	0.00%
Hex2Cer d18:0/15:0; Hex2Cer d18:0/14:1 (1OH)	850.6253	15.17%	0.00%
Hex2Cer d18:0/14:0 (1OH); HexCer d18:0/27:2	852.6046	15.18%	0.00%
HexCer d18:1/27:1; HexCer d18:1/26:2 (1OH)	852.7285	14.85%	0.00%
HexCer d18:1/27:0; HexCer d18:1/26:1 (1OH)	854.7441	17.57%	0.00%
HexCer d18:0/27:1; HexCer d18:0/26:2 (1OH)	854.7442	14.86%	0.00%
HexCer d18:1/26:0 (1OH)	856.7237	17.58%	0.00%
HexCer d18:0/27:0; HexCer d18:0/26:1 (1OH)	856.7598	17.58%	0.00%
Hex2Cer d18:1/16:2	858.5940	17.19%	0.00%
HexCer d18:0/26:0 (1OH)	858.7394	17.59%	0.00%
Hex2Cer d18:1/16:1; Hex2Cer d18:1/15:2 (1OH)	860.6096	15.71%	0.00%
Hex2Cer d18:0/16:2	860.6097	17.20%	0.00%
Hex2Cer d18:0/16:1; Hex2Cer d18:0/15:2 (1OH)	862.6253	15.72%	0.00%
Hex2Cer d18:1/16:0; Hex2Cer d18:1/15:1 (1OH)	862.6253	15.72%	0.00%
Hex2Cer d18:0/16:0; Hex2Cer d18:0/15:1 (1OH)	864.6410	15.73%	0.00%
HexCer d18:1/28:2; Hex2Cer d18:1/15:0 (1OH)	864.7285	15.73%	0.00%
HexCer d18:1/28:1; HexCer d18:1/27:2 (1OH)	866.7441	18.18%	0.00%
HexCer d18:0/28:2; Hex2Cer d18:0/15:0 (1OH)	866.7442	15.74%	0.00%
HexCer d18:0/28:1; HexCer d18:0/27:2 (1OH)	868.7598	18.20%	0.00%
HexCer d18:1/28:0; HexCer d18:1/27:1 (1OH)	868.7598	18.20%	0.00%
HexCer d18:1/27:0 (1OH)	870.7394	18.21%	0.00%
HexCer d18:0/28:0; HexCer d18:0/27:1 (1OH)	870.7755	18.21%	0.00%
Hex2Cer d18:1/17:2	872.6096	17.81%	0.00%
HexCer d18:0/27:0 (1OH)	872.7551	18.22%	0.00%
Hex2Cer d18:0/17:2	874.6253	17.82%	0.00%
Hex2Cer d18:1/17:1; Hex2Cer d18:1/16:2 (1OH)	874.6253	16.28%	0.00%
Hex2Cer d18:1/17:0; Hex2Cer d18:1/16:1 (1OH)	876.6409	16.29%	0.00%
Hex2Cer d18:0/17:1; Hex2Cer d18:0/16:2 (1OH)	876.6410	16.29%	0.00%
Hex2Cer d18:1/16:0 (1OH)	878.6202	16.30%	0.00%
Hex2Cer d18:0/17:0; Hex2Cer d18:0/16:1 (1OH)	878.6566	16.30%	0.00%
Hex2Cer d18:0/16:0 (1OH)	880.6359	16.31%	0.00%

HexCer d18:1/29:1; HexCer d18:1/28:2 (1OH)	880.7598	15.96%	0.00%
HexCer d18:1/29:0; HexCer d18:1/28:1 (1OH)	882.7754	18.84%	0.00%
HexCer d18:0/29:1; HexCer d18:0/28:2 (1OH)	882.7755	15.97%	0.00%
HexCer d18:1/28:0 (1OH)	884.7730	18.85%	0.00%
HexCer d18:0/29:0; HexCer d18:0/28:1 (1OH)	884.7911	18.85%	0.00%
Hex2Cer d18:1/18:2	886.6252	18.44%	0.00%
HexCer d18:0/28:0 (1OH)	886.7887	18.87%	0.00%
Hex2Cer d18:0/18:2	888.6409	18.45%	0.00%
Hex2Cer d18:1/18:1; Hex2Cer d18:1/17:2 (1OH)	888.6409	16.86%	0.00%
Hex2Cer d18:1/18:0; Hex2Cer d18:1/17:1 (1OH)	890.6565	16.87%	0.00%
Hex2Cer d18:0/18:1; Hex2Cer d18:0/17:2 (1OH)	890.6566	16.87%	0.00%
Hex2Cer d18:1/17:0 (1OH)	892.6359	16.88%	0.00%
Hex2Cer d18:0/18:0; Hex2Cer d18:0/17:1 (1OH)	892.6722	16.88%	0.00%
Hex2Cer d18:0/17:0 (1OH)	894.6516	16.90%	0.00%
HexCer d18:1/30:1; HexCer d18:1/29:2 (1OH)	894.7757	16.53%	0.00%
HexCer d18:1/30:0; HexCer d18:1/29:1 (1OH)	896.7910	19.49%	0.00%
HexCer d18:0/30:1; HexCer d18:0/29:2 (1OH)	896.7914	16.54%	0.00%
HexCer d18:1/29:0 (1OH)	898.7707	19.51%	0.00%
HexCer d18:0/30:0; HexCer d18:0/29:1 (1OH)	898.8067	19.51%	0.00%
Hex2Cer d18:1/19:2	900.6408	19.08%	0.00%
HexCer d18:0/29:0 (1OH)	900.7864	19.52%	0.00%
Hex2Cer d18:0/19:2	902.6565	19.09%	0.00%
Hex2Cer d18:1/19:1; Hex2Cer d18:1/18:2 (1OH)	902.6565	17.45%	0.00%
Hex2Cer d18:1/19:0; Hex2Cer d18:1/18:1 (1OH)	904.6721	17.47%	0.00%
Hex2Cer d18:0/19:1; Hex2Cer d18:0/18:2 (1OH)	904.6722	17.47%	0.00%
Hex2Cer d18:1/18:0 (1OH)	906.6442	17.48%	0.00%
Hex2Cer d18:0/19:0; Hex2Cer d18:0/18:1 (1OH)	906.6878	17.48%	0.00%
Hex2Cer d18:0/18:0 (1OH)	908.6599	17.49%	0.00%
Hex2Cer d18:1/20:2	914.6565	0.00%	0.00%
Hex2Cer d18:1/20:1; Hex2Cer d18:1/19:2 (1OH)	916.6721	18.06%	0.00%
Hex2Cer d18:0/20:2	916.6722	0.00%	0.00%
Hex2Cer d18:0/20:1; Hex2Cer d18:0/19:2 (1OH)	918.6878	18.07%	0.00%
Hex2Cer d18:1/20:0; Hex2Cer d18:1/19:1 (1OH)	918.6878	18.07%	0.00%
Hex2Cer d18:1/19:0 (1OH)	920.6672	18.09%	0.00%
Hex2Cer d18:0/20:0; Hex2Cer d18:0/19:1 (1OH)	920.7035	18.09%	0.00%
Hex2Cer d18:0/19:0 (1OH)	922.6829	18.10%	0.00%
Hex2Cer d18:1/21:2	928.6721	0.00%	0.00%
Hex2Cer d18:0/21:2	930.6878	0.00%	0.00%
Hex2Cer d18:1/21:1; Hex2Cer d18:1/20:2 (1OH)	930.6878	18.68%	0.00%
Hex2Cer d18:1/21:0; Hex2Cer d18:1/20:1 (1OH)	932.7034	18.69%	0.00%
Hex2Cer d18:0/21:1; Hex2Cer d18:0/20:2 (1OH)	932.7035	18.69%	0.00%
Hex2Cer d18:1/20:0 (OH)	934.6828	18.70%	0.00%
Hex2Cer d18:0/21:0; Hex2Cer d18:0/20:1 (1OH)	934.7191	18.70%	0.00%
Hex2Cer d18:0/20:0 (OH)	936.6985	18.72%	0.00%
Hex2Cer d18:1/22:2	942.6877	0.00%	0.00%
Hex2Cer d18:0/22:2	944.7034	0.00%	0.00%
Hex2Cer d18:1/22:1; Hex2Cer d18:1/21:2 (1OH)	944.7034	19.31%	0.00%
Hex2Cer d18:1/22:0; Hex2Cer d18:1/21:1 (1OH)	946.7190	19.32%	0.00%
Hex2Cer d18:0/22:1; Hex2Cer d18:0/21:2 (1OH)	946.7191	19.32%	0.00%
Hex2Cer d18:1/21:0 (1OH)	948.6985	19.34%	0.00%
Hex2Cer d18:0/22:0; Hex2Cer d18:0/21:1 (1OH)	948.7347	19.34%	0.00%
Hex2Cer d18:0/21:0 (1OH)	950.7142	19.35%	0.00%
Hex2Cer d18:1/23:2	956.7033	0.00%	0.00%
Hex2Cer d18:0/23:2	958.7190	0.00%	0.00%
Hex2Cer d18:1/23:1; Hex2Cer d18:1/22:2 (1OH)	958.7190	19.95%	0.00%
Hex2Cer d18:1/23:0; Hex2Cer d18:1/22:1 (1OH)	960.7346	19.97%	0.00%
Hex2Cer d18:0/23:1; Hex2Cer d18:0/22:2 (1OH)	960.7347	19.97%	0.00%
Hex2Cer d18:1/22:0 (1OH)	962.7141	19.98%	0.00%
Hex2Cer d18:0/23:0; Hex2Cer d18:0/22:1 (1OH)	962.7503	19.98%	0.00%
Hex2Cer d18:0/22:0 (1OH)	964.7298	19.99%	0.00%
Hex2Cer d18:1/24:2	970.7190	0.00%	0.00%

Hex2Cer d18:1/24:1; Hex2Cer d18:1/23:2 (1OH)	972.7346	20.61%	0.00%
Hex2Cer d18:0/24:2	972.7347	0.00%	0.00%
Hex2Cer d18:0/24:1; Hex2Cer d18:0/23:2 (1OH)	974.7503	20.62%	0.00%
Hex2Cer d18:1/24:0; Hex2Cer d18:1/23:1 (1OH)	974.7503	20.62%	0.00%
Hex2Cer d18:1/23:0 (1OH)	976.7298	20.64%	0.00%
Hex2Cer d18:0/24:0; Hex2Cer d18:0/23:1 (1OH)	976.7660	20.64%	0.00%
Hex2Cer d18:0/23:0 (1OH)	978.7455	20.65%	0.00%
Hex2Cer d18:1/25:2	984.7346	0.00%	0.00%
Hex2Cer d18:0/25:2	986.7503	0.00%	0.00%
Hex2Cer d18:1/25:1; Hex2Cer d18:1/24:2 (1OH)	986.7503	21.28%	0.00%
Hex2Cer d18:1/25:0; Hex2Cer d18:1/24:1 (1OH)	988.7659	21.29%	0.00%
Hex2Cer d18:0/25:1; Hex2Cer d18:0/24:2 (1OH)	988.7660	21.29%	0.00%
Hex2Cer d18:1/24:0 (1OH)	990.7454	21.30%	0.00%
Hex2Cer d18:0/25:0; Hex2Cer d18:0/24:1 (1OH)	990.7816	21.30%	0.00%
Hex2Cer d18:0/24:0 (1OH)	992.7611	21.32%	0.00%
Hex2Cer d18:1/26:2	998.7502	0.00%	0.00%
Hex2Cer d18:0/26:2	1000.7659	0.00%	0.00%
Hex2Cer d18:1/26:1; Hex2Cer d18:1/25:2 (1OH)	1000.7659	21.96%	0.00%
Hex2Cer d18:1/26:0; Hex2Cer d18:1/25:1 (1OH)	1002.7815	21.97%	0.00%
Hex2Cer d18:0/26:1; Hex2Cer d18:0/25:2 (1OH)	1002.7816	21.97%	0.00%
Hex2Cer d18:1/25:0 (1OH)	1004.7611	21.98%	0.00%
Hex2Cer d18:0/26:0; Hex2Cer d18:0/25:1 (1OH)	1004.7972	21.98%	0.00%
Hex2Cer d18:0/25:0 (1OH)	1006.7768	22.00%	0.00%
Hex2Cer d18:1/27:2	1012.7658	0.00%	0.00%
Hex2Cer d18:0/27:2	1014.7815	0.00%	0.00%
Hex2Cer d18:1/27:1; Hex2Cer d18:1/26:2 (1OH)	1014.7815	22.65%	0.00%
Hex2Cer d18:1/27:0; Hex2Cer d18:1/26:1 (1OH)	1016.7971	22.66%	0.00%
Hex2Cer d18:0/27:1; Hex2Cer d18:0/26:2 (1OH)	1016.7972	22.66%	0.00%
Hex2Cer d18:1/26:0 (1OH)	1018.7767	22.68%	0.00%
Hex2Cer d18:0/27:0; Hex2Cer d18:0/26:1 (1OH)	1018.8128	22.68%	0.00%
Hex2Cer d18:0/26:0 (1OH)	1020.7924	22.69%	0.00%
Hex2Cer d18:1/28:2	1026.7815	0.00%	0.00%
Hex2Cer d18:1/28:1; Hex2Cer d18:1/27:2 (1OH)	1028.7971	23.35%	0.00%
Hex2Cer d18:0/28:2	1028.7972	0.00%	0.00%
Hex2Cer d18:0/28:1; Hex2Cer d18:0/27:2 (1OH)	1030.8128	23.37%	0.00%
Hex2Cer d18:1/28:0; Hex2Cer d18:1/27:1 (1OH)	1030.8128	23.37%	0.00%
Hex2Cer d18:1/27:0 (1OH)	1032.7924	23.38%	0.00%
Hex2Cer d18:0/28:0; Hex2Cer d18:0/27:1 (1OH)	1032.8285	23.38%	0.00%
Hex2Cer d18:0/27:0 (1OH)	1034.8081	23.40%	0.00%
Hex2Cer d18:1/29:1; Hex2Cer d18:1/28:2 (1OH)	1042.8128	0.00%	0.00%
Hex2Cer d18:1/29:0; Hex2Cer d18:1/28:1 (1OH)	1044.8284	24.08%	0.00%
Hex2Cer d18:0/29:1; Hex2Cer d18:0/28:2 (1OH)	1044.8285	0.00%	0.00%
Hex2Cer d18:1/28:0 (1OH)	1046.8260	24.10%	0.00%
Hex2Cer d18:0/29:0; Hex2Cer d18:0/28:1 (1OH)	1046.8441	24.09%	0.00%
Hex2Cer d18:0/28:0 (1OH)	1048.8417	24.11%	0.00%
Hex2Cer d18:1/30:1; Hex2Cer d18:1/29:2 (1OH)	1056.8287	0.00%	0.00%
Hex2Cer d18:1/30:0; Hex2Cer d18:1/29:1 (1OH)	1058.8440	24.81%	0.00%
Hex2Cer d18:0/30:1; Hex2Cer d18:0/29:2 (1OH)	1058.8444	0.00%	0.00%
Hex2Cer d18:1/29:0 (1OH)	1060.8237	24.83%	0.00%
Hex2Cer d18:0/30:0; Hex2Cer d18:0/29:1 (1OH)	1060.8597	24.83%	0.00%
Hex2Cer d18:0/29:0 (1OH)	1062.8394	24.84%	0.00%
LPE 6:0	314.1363	0.00%	0.00%
LPE 8:0	342.1676	0.00%	0.00%
LPE 10:0	370.1989	0.00%	0.00%
LPE 12:0	398.2302	0.00%	0.00%
LPE 14:0 (IS)	426.2615	0.00%	0.00%
LPE P-16:0; LPE O-16:1	438.2979	0.00%	0.00%
LPE O-16:0; LPE 15:0	440.2772	3.95%	0.00%
LPE 16:2	450.2615	0.00%	0.00%
LPE 16:1	452.2772	4.15%	0.00%
LPE 16:0	454.2928	4.16%	0.00%

LPE P-18:0; LPE O-18:1; LPE 17:1	466.3298	0.00%	0.00%
LPE O-18:0; LPE 17:0	468.3085	4.49%	0.00%
LPE 18:4	474.2615	0.00%	0.00%
LPE 18:3	476.2772	4.68%	0.00%
LPE 18:2	478.2928	4.69%	0.00%
LPE 18:1	480.3085	4.69%	0.00%
LPE 18:0	482.3241	4.70%	0.00%
LPE P-20:0; LPE O-20:1	494.3605	0.00%	0.00%
LPE O-20:0; LPE 19:0	496.3398	5.08%	0.00%
LPE 20:5	500.2766	0.00%	0.00%
LPE 20:4	502.2923	5.26%	0.00%
LPE 20:3	504.3079	5.27%	0.00%
LPE 20:2	506.3241	5.27%	0.00%
LPE 20:1	508.3398	5.28%	0.00%
LPE 20:0	510.3554	5.29%	0.00%
LPE P-22:0; LPE O-22:1	522.3918	0.00%	0.00%
LPE O-22:0; LPE 21:0	524.3711	5.71%	0.00%
LPE 22:6	526.2928	5.72%	0.00%
LPE 22:5	528.3079	5.89%	0.00%
LPE 22:4	530.3235	5.89%	0.00%
LPE 22:1	536.3711	0.00%	0.00%
LPE 22:0	538.3867	5.92%	0.00%
LPE P-24:0; LPE O-24:1	550.4231	0.00%	0.00%
LPE O-24:0; LPE 23:0	552.4024	6.40%	0.00%
LPE 24:1	564.4024	0.00%	0.00%
LPE 24:0	566.4180	6.61%	0.00%
LPE 25:0	580.4337	0.00%	0.00%
LPE 26:0	594.4493	0.00%	0.00%
LPE 27:0	608.4650	0.00%	0.00%
LPE 28:0	622.4806	0.00%	0.00%
PE 28:0	636.4599	0.00%	0.00%
PE 29:0	650.4755	0.00%	0.00%
PE 30:1	662.4755	0.00%	0.00%
PE 30:0	664.4912	9.17%	0.00%
PE P-32:1; PE-31:2	674.5119	0.00%	0.00%
PE P-32:0; PE-31:1	676.4912	9.83%	0.00%
PE O-32:0; PE-31:0	678.5068	9.84%	0.00%
PE 32:3; PE P-33:2	686.4755	0.00%	0.00%
PE 32:2; PE P-33:1	688.4912	10.03%	0.00%
PE 32:1; PE P-33:0	690.5068	10.04%	0.00%
PE 32:0; PE O-33:0	692.5225	10.05%	0.00%
PE 32:0	692.5225	10.05%	0.00%
PE O-34:3/P-34:2	700.5276	0.00%	0.00%
PE P-34:1; PE 33:2	702.5068	0.00%	0.00%
PE O-34:2/P-34:1	702.5432	10.75%	0.00%
PE P-34:0; PE 33:1	704.5225	10.76%	0.00%
PE O-34:1/P-34:0	704.5589	10.76%	0.00%
PE O-34:0; PE 33:0	706.5381	10.77%	0.00%
PE 34:4; PE P-35:3	712.4912	0.00%	0.00%
PE 34:3; PE P-35:2	714.5068	10.95%	0.00%
PE 34:2; PE P-35:1	716.5225	10.96%	0.00%
PE 34:1; PE P-35:0	718.5381	10.97%	0.00%
PE 34:0; PE P-36:6	720.5538	10.98%	0.00%
PE P-36:5; PE 35:6	722.4756	11.69%	0.00%
PE O-36:6/P-36:5	722.5119	0.00%	0.00%
PE P-36:4; PE 35:5	724.4912	11.70%	0.00%
PE O-36:5/P-36:4	724.5276	11.70%	0.00%
PE P-36:3; PE 35:4	726.5068	11.71%	0.00%
PE O-36:4/P-36:3	726.5432	11.71%	0.00%
PE P-36:2; PE 35:3	728.5225	11.72%	0.00%
PE O-36:3/P-36:2	728.5589	11.72%	0.00%

PE P-36:1; PE 35:2	730.5381	11.73%	0.00%
PE O-36:2/P-36:1	730.5745	11.73%	0.00%
PE P-36:0; PE 35:1	732.5538	11.74%	0.00%
PE 36:7; PE O-36:0; PE 35:0	734.5694	11.75%	0.00%
PE 36:6; PE P-37:5	736.4912	11.90%	0.00%
PE 36:5; PE P-37:4	738.5068	11.91%	0.00%
PE 36:4; PE P-37:3	740.5225	11.92%	0.00%
PE 36:3; PE P-37:2	742.5381	11.93%	0.00%
PE 36:2; PE P-37:1	744.5538	11.94%	0.00%
PE 36:1; PE P-37:0	746.5694	11.95%	0.00%
PE O-38:7/P-38:6	748.5276	0.00%	0.00%
PE 36:0; PE P-38:6	748.5851	11.96%	0.00%
PE P-38:5; PE 37:6	750.5063	12.71%	0.00%
PE O-38:6/P-38:5	750.5432	12.71%	0.00%
PE P-38:4; PE 37:5	752.5220	14.35%	0.00%
PE O-38:5/P-38:4	752.5589	12.72%	0.00%
PE P-38:3; PE 37:4	754.5376	14.36%	0.00%
PE O-38:4/P-38:3	754.5745	12.73%	0.00%
PE P-38:2; PE 37:3	756.5538	14.37%	0.00%
PE O-38:3/P-38:2	756.5902	12.74%	0.00%
PE P-38:1; PE 37:2	758.5694	14.39%	0.00%
PE P-38:0; PE 37:1	760.5851	14.40%	0.00%
PE 38:7; PE O-38:0; PE 37:0	762.6007	14.41%	0.00%
PE 38:6; PE P-39:5	764.5225	14.55%	0.00%
PE 38:5; PE P-39:4	766.5382	14.56%	0.00%
PE 38:4; PE P-40:10; PE P-29:3	768.5538	14.57%	0.00%
PE 38:3; PE P-40:9; PE P-39:2	770.5694	14.586%	0.00%
PE 38:2; PE P-40:8; PE P-39:1	772.5851	14.60%	0.00%
PE 38:1; PE P-40:7; PE P-39:0	774.6007	14.61%	0.00%
PE O-40:7/P-40:6	776.5589	0.00%	0.00%
PE 38:0; PE P-40:6; PE O-39:0	776.6164	14.62%	0.00%
PE P-40:5; PE 39:6	778.5382	13.78%	0.00%
PE O-40:6/P-40:5	778.5745	13.78%	0.00%
PE P-40:4; PE 39:5	780.5538	13.79%	0.00%
PE O-40:5/P-40:4	780.5902	13.79%	0.00%
PE P-40:3; PE 39:4	782.5694	15.51%	0.00%
PE 40:10; PE P-40:2; PE 39:3	784.4912	15.52%	0.00%
PE 40:9; PE P-40:1; PE 39:2	786.5069	15.66%	0.00%
PE 40:8; PE P-40:0; PE 39:1	788.5225	15.67%	0.00%
PE 40:7; PE O-40:0; PE 39:0	790.5381	15.69%	0.00%
PE 40:6; PE P-41:5	792.5538	15.70%	0.00%
PE 40:5; PE P-41:4	794.5695	15.71%	0.00%
PE 40:4; PE P-42:10; PE P-41:3	796.5851	15.72%	0.00%
PE 40:3; PE P-42:9; PE P-41:2	798.6008	15.73%	0.00%
PE 40:2; PE P-42:8; PE P-41:1	800.6164	15.75%	0.00%
PE 40:1; PE P-42:7; PE P-41:0	802.6320	15.76%	0.00%
PE 40:0; PE P-42:6; PE O-41:0	804.6477	15.77%	0.00%
PE P-42:5; PE 41:6	806.5694	14.90%	0.00%
PE O-42:6/P-42:5	806.6058	0.00%	0.00%
PE P-42:4; PE 41:5	808.5851	16.69%	0.00%
PE P-42:3; PE 41:4	810.6007	16.71%	0.00%
PE 42:10; PE P-42:2; PE 41:3	812.5225	16.72%	0.00%
PE 42:9; PE P-42:1; PE 41:2	814.5382	16.85%	0.00%
PE 42:8; PE P-42:0; PE 41:1	816.5538	16.87%	0.00%
PE 42:7; PE O-42:0	818.5694	16.88%	0.00%
PE 42:6; PE P-43:5	820.5851	16.89%	0.00%
PE 42:5; PE P-43:4	822.6007	16.91%	0.00%
PE 42:4; PE P-43:3	824.6164	16.92%	0.00%
PE 42:3; PE P-43:2	826.6320	16.93%	0.00%
PE 42:2; PE P-43:1	828.6477	16.94%	0.00%
PE 42:1; PE P-43:0	830.6633	16.96%	0.00%

PE 42:0; PE O-43:0	832.6790	16.97%	0.00%
PE 44:0	860.7103	0.00%	0.00%
LPI 6:0	450.1734	0.00%	0.00%
LPI 8:0	478.2047	0.00%	0.00%
LPI 10:0	506.2360	0.00%	0.00%
LPI 12:0	534.2673	0.00%	0.00%
LPI 14:0	562.2986	0.00%	0.00%
LPI P-16:0; LPI O-16:1	574.3350	0.00%	0.00%
LPI O-16:0; LPI 15:0	576.3143	6.16%	0.00%
LPI 16:2	586.2986	0.00%	0.00%
PI 16:0	587.2827	0.00%	0.00%
LPI 16:1	588.3143	6.36%	0.00%
LPI 16:0	590.3299	6.37%	0.00%
LPI P-18:0; LPI O-18:1; LPI 17:1	602.3669	0.00%	0.00%
PI 16:0; LPI O-18:0; LPI 17:0 (IS)	604.3456	6.80%	0.00%
LPI 18:4	610.2986	0.00%	0.00%
LPI 18:3	612.3143	6.99%	0.00%
LPI 18:2	614.3299	6.99%	0.00%
LPI 18:1	616.3456	7.00%	0.00%
LPI 18:0	618.3612	7.01%	0.00%
LPI P-20:0; LPI O-20:1	630.3976	0.00%	0.00%
LPI O-20:0; LPI 19:0	632.3769	7.49%	0.00%
LPI 20:5	636.3137	0.00%	0.00%
LPI 20:4	638.3294	7.67%	0.00%
LPI 20:3	640.3450	7.68%	0.00%
LPI 20:2	642.3612	7.68%	0.00%
LPI 20:1	644.3769	7.69%	0.00%
LPI 20:0	646.3925	7.70%	0.00%
LPI P-22:0; LPI O-22:1	658.4289	0.00%	0.00%
LPI O-22:0; LPI 21:0	660.4082	8.23%	0.00%
LPI 22:6	662.3299	8.23%	0.00%
LPI 22:5	664.3450	8.40%	0.00%
LPI 22:4	666.3606	8.41%	0.00%
LPI 22:1	672.4082	0.00%	0.00%
LPI 22:0	674.4238	8.44%	0.00%
LPI P-24:0; LPI O-24:1	686.4602	0.00%	0.00%
LPI O-24:0; LPI 23:0	688.4395	9.01%	0.00%
LPI 24:1	700.4395	0.00%	0.00%
LPI 24:0	702.4551	9.22%	0.00%
LPI 25:0	716.4708	0.00%	0.00%
LPI 26:0	730.4864	0.00%	0.00%
LPI 27:0	744.5021	0.00%	0.00%
LPI 28:0	758.5177	0.00%	0.00%
PI 28:0	772.4970	0.00%	0.00%
PI 29:0	786.5126	0.00%	0.00%
PI 30:1	798.5126	0.00%	0.00%
PI 30:0	800.5283	10.04%	0.00%
PI P-32:1; PI-31:2	810.5490	0.00%	0.00%
PI P-32:0; PI-31:1	812.5283	12.85%	0.00%
PI O-32:0; PI-31:0	814.5440	12.86%	0.00%
PI 32:3; PI P-33:2	822.5126	0.00%	0.00%
PI 32:2; PI P-33:1	824.5283	13.05%	0.00%
PI 32:1; PI P-33:0	826.5440	13.07%	0.00%
PI 32:0; PI O-33:0	828.5596	13.08%	0.00%
PI P-34:1; PI 33:2	838.5440	0.00%	0.00%
PI P-34:0; PI 33:1	840.5596	13.88%	0.00%
PI O-34:0; PI 33:0	842.5753	13.90%	0.00%
PI 34:4; PI P-35:3	848.5283	0.00%	0.00%
PI 34:3; PI P-35:2	850.5440	14.08%	0.00%
PI 34:2; PI P-35:1	852.5596	14.09%	0.00%
PI 34:1; PI P-35:0	854.5753	14.10%	0.00%

PI 34:0; PI P-36:6	856.5909	14.11%	0.00%
PI P-36:5; PI 35:6	858.5127	14.91%	0.00%
PI 36:4	859.5331	0.00%	0.00%
PI P-36:4; PI 35:5	860.5283	14.92%	0.00%
PI P-36:3; PI 35:4	862.5440	14.93%	0.00%
PI P-36:2; PI 35:3	864.5596	14.94%	0.00%
PI P-36:1; PI 35:2	866.5753	14.95%	0.00%
PI P-36:0; PI 35:1	868.5909	14.96%	0.00%
PI 36:7; PI O-36:0; PI 35:0	870.6066	14.97%	0.00%
PI 36:6; PI P-37:5	872.5283	15.12%	0.00%
PI 36:5; PI P-37:4	874.5440	15.13%	0.00%
PI 36:4; PI P-37:3	876.5596	15.14%	0.00%
PI 36:3; PI P-37:2	878.5753	15.15%	0.00%
PI 36:2; PI P-37:1	880.5909	15.16%	0.00%
PI 36:1; PI P-37:0	882.6066	15.18%	0.00%
PI 36:0; PI P-38:6	884.6222	15.19%	0.00%
PI 38:5	885.5488	0.00%	0.00%
PI P-38:5; PI 37:6	886.5434	16.03%	0.00%
PI 38:4	887.5644	0.00%	0.00%
PI P-38:4; PI 37:5	888.5591	16.04%	0.00%
PI 38:3	889.5801	0.00%	0.00%
PI P-38:3; PI 37:4	890.5747	16.06%	0.00%
PI P-38:2; PI 37:3	892.5909	16.07%	0.00%
PI P-38:1; PI 37:2	894.6066	16.08%	0.00%
PI P-38:0; PI 37:1	896.6222	16.09%	0.00%
PI 38:7; PI O-38:0; PI 37:0	898.6379	16.10%	0.00%
PI 38:6; PI P-39:5	900.5596	16.25%	0.00%
PI 38:5; PI P-39:4	902.5753	16.26%	0.00%
PI 38:4; PI P-40:10; PI P-29:3	904.5909	16.27%	0.00%
PI 38:3; PI P-40:9; PI P-39:2	906.6066	16.28%	0.00%
PI 38:2; PI P-40:8; PI P-39:1	908.6222	16.29%	0.00%
PI 40:7	909.5488	0.00%	0.00%
PI 38:1; PI P-40:7; PI P-39:0	910.6379	16.31%	0.00%
PI 40:6	911.5644	0.00%	0.00%
PI 38:0; PI P-40:6; PI O-39:0	912.6535	16.32%	0.00%
PI P-40:5; PI 39:6	914.5753	17.21%	0.00%
PI P-40:4; PI 39:5	916.5909	17.22%	0.00%
PI P-40:3; PI 39:4	918.6066	17.23%	0.00%
PI 40:10; PI P-40:2; PI 39:3	920.5283	17.25%	0.00%
PI 40:9; PI P-40:1; PI 39:2	922.5440	17.38%	0.00%
PI 40:8; PI P-40:0; PI 39:1	924.5596	17.40%	0.00%
PI 40:7; PI O-40:0; PI 39:0	926.5753	17.41%	0.00%
PI 40:6; PI P-41:5	928.5909	17.42%	0.00%
PI 40:5; PI P-41:4	930.6066	17.43%	0.00%
PI 40:4; PI P-42:10; PI P-41:3	932.6222	17.45%	0.00%
PI 40:3; PI P-42:9; PI P-41:2	934.6379	17.46%	0.00%
PI 40:2; PI P-42:8; PI P-41:1	936.6535	17.47%	0.00%
PI 40:1; PI P-42:7; PI P-41:0	938.6692	17.48%	0.00%
PI 40:0; PI P-42:6; PI O-41:0	940.6848	17.50%	0.00%
PI P-42:5; PI 41:6	942.6066	18.43%	0.00%
PI P-42:4; PI 41:5	944.6222	18.44%	0.00%
PI P-42:3; PI 41:4	946.6379	18.46%	0.00%
PI 42:10; PI P-42:2; PI 41:3	948.5596	18.47%	0.00%
PI 42:9; PI P-42:1; PI 41:2	950.5753	18.61%	0.00%
PI 42:8; PI P-42:0; PI 41:1	952.5909	18.62%	0.00%
PI 42:7; PI O-42:0	954.6066	18.63%	0.00%
PI 42:6; PI P-43:5	956.6222	18.65%	0.00%
PI 42:5; PI P-43:4	958.6379	18.66%	0.00%
PI 42:4; PI P-43:3	960.6535	18.67%	0.00%
PI 42:3; PI P-43:2	962.6692	18.68%	0.00%
PI 42:2; PI P-43:1	964.6848	18.70%	0.00%

PI 42:1; PI P-43:0	966.7005	18.71%	0.00%
PI 42:0; PI O-43:0	968.7161	18.72%	0.00%
PI 44:0	996.7474	0.00%	0.00%
LPC 6:0	356.1833	0.00%	0.00%
LPC 8:0	384.2146	0.00%	0.00%
LPC 10:0	412.2459	0.00%	0.00%
LPC 12:0	440.2772	0.00%	0.00%
LPC 14:0	468.3085	0.00%	0.00%
LPC P-16:0; LPC O-16:1	480.3449	0.00%	0.00%
LPC O-16:0; LPC 15:0	482.3241	4.78%	0.00%
LPC 16:2	492.3085	0.00%	0.00%
LPC 16:1	494.3241	4.98%	0.00%
LPC 16:0	496.3398	4.99%	0.00%
LPC P-18:0; LPC O-18:1; LPC 17:1	508.3767	0.00%	0.00%
LPC O-18:0; LPC 17:0 (IS)	510.3554	5.39%	0.00%
LPC O-18:0	510.3918	0.00%	0.00%
LPC 18:4	516.3085	0.00%	0.00%
LPC 18:3	518.3241	5.58%	0.00%
LPC 18:2	520.3398	5.58%	0.00%
LPC 18:1	522.3554	5.59%	0.00%
LPC 18:1	522.3554	5.59%	0.00%
LPC 18:0	524.3711	5.60%	0.00%
LPC P-20:0; LPC O-20:1	536.4075	0.00%	0.00%
LPC O-20:0; LPC 19:0	538.3867	6.05%	0.00%
LPC 20:5	542.3235	0.00%	0.00%
LPC 20:4	544.3392	6.23%	0.00%
LPC 20:3	546.3548	6.24%	0.00%
LPC 20:2	548.3711	6.25%	0.00%
LPC 20:1	550.3867	6.25%	0.00%
LPC 20:0	552.4024	6.26%	0.00%
LPC P-22:0; LPC O-22:1	564.4388	0.00%	0.00%
LPC O-22:0; LPC 21:0	566.4180	6.76%	0.00%
LPC 22:6	568.3398	6.77%	0.00%
LPC 22:5	570.3548	6.93%	0.00%
LPC 22:4	572.3704	6.94%	0.00%
LPC 22:1	578.4180	0.00%	0.00%
LPC 22:0	580.4337	6.97%	0.00%
LPC P-24:0; LPC O-24:1	592.4701	0.00%	0.00%
LPC O-24:0; LPC 23:0	594.4493	7.52%	0.00%
LPC 24:1	606.4493	0.00%	0.00%
LPC 24:0	608.4650	7.73%	0.00%
SM 28:2	617.4653	0.00%	0.00%
SM 28:1	619.4809	8.04%	0.00%
SM 28:0	621.4966	8.05%	0.00%
LPC 25:0	622.4806	0.00%	37.46%
SM 29:2	631.4809	0.00%	0.00%
SM 29:1	633.4966	8.45%	0.00%
SM 29:0	635.5123	8.46%	0.00%
LPC 26:0	636.4963	0.00%	38.57%
SM 30:2	645.4966	0.00%	0.00%
SM 30:1	647.5123	8.88%	0.00%
SM 30:0	649.5279	8.89%	0.00%
LPC 27:0	650.5119	0.00%	39.67%
SM 31:2	659.5123	0.00%	0.00%
SM 31:1	661.5279	9.32%	0.00%
SM 31:0	663.5436	9.33%	0.00%
LPC 28:0	664.5276	0.00%	40.78%
SM 32:2	673.5279	0.00%	0.00%
SM 32:1	675.5436	9.77%	0.00%
SM d32:1	675.5436	0.00%	0.00%
SM 32:0	677.5592	9.78%	0.00%

PC 28:0	678.5068	0.00%	41.88%
SM 33:2	687.5436	0.00%	0.00%
SM 33:1	689.5592	10.23%	0.00%
PC O-30:1/P-30:0	690.5432	0.00%	0.00%
SM 33:0	691.5749	10.24%	0.00%
PC 29:0	692.5225	0.00%	42.99%
PC O-30:0	692.5589	10.30%	0.00%
SM 34:2	701.5592	0.00%	0.00%
SM 34:1	703.5749	10.70%	0.00%
PC 30:1	704.5225	0.00%	44.07%
SM 34:0	705.5905	10.71%	42.64%
PC 30:0	706.5381	10.51%	44.09%
SM 35:2	715.5749	0.00%	0.00%
PC P-32:1; PC-31:2	716.5589	0.00%	45.15%
PC O-32:2/P-32:1	716.5589	0.00%	0.00%
SM 35:1	717.5905	11.19%	44.81%
PC P-32:0; PC-31:1	718.5381	11.24%	45.17%
PC O-32:1/P-32:0	718.5745	11.24%	0.00%
SM 35:0	719.6062	11.20%	44.83%
PC O-32:0; PC-31:0	720.5538	11.25%	45.20%
PC O-32:0	720.5902	11.25%	0.00%
PC 32:3; PC P-33:2	728.5225	0.00%	0.00%
SM 36:2	729.5905	0.00%	44.80%
PC 32:2; PC P-33:1	730.5381	11.44%	46.26%
SM 36:1	731.6062	11.69%	44.82%
PC 32:1; PC P-33:0	732.5538	11.46%	46.28%
SM 36:0	733.6218	11.70%	44.85%
PC 32:0; PC O-33:0	734.5694	11.47%	46.30%
PC O-34:3/P-34:2	742.5745	0.00%	0.00%
SM 37:2	743.6062	0.00%	0.00%
PC P-34:1; PC 33:2	744.5538	0.00%	47.36%
PC O-34:2/P-34:1	744.5902	12.23%	0.00%
SM 37:1	745.6218	12.20%	47.02%
PC P-34:0; PC 33:1	746.5694	12.25%	47.38%
PC O-34:1/P-34:0	746.6058	12.25%	0.00%
SM 37:0	747.6375	12.21%	47.04%
PC O-34:0; PC 33:0	748.5851	12.26%	47.41%
PC 34:4; PC P-35:3	754.5382	0.00%	0.00%
PC 34:3; PC P-35:2	756.5538	12.44%	0.00%
SM 38:2	757.6218	0.00%	47.01%
PC 34:2; PC P-35:1	758.5694	12.45%	48.46%
SM 38:1	759.6375	12.72%	47.03%
PC 34:1; PC P-35:0	760.5851	12.46%	48.49%
SM 38:0	761.6531	12.74%	47.06%
PC 34:0; PC P-36:6	762.6007	12.47%	48.51%
PC P-36:5; PC 35:6	764.5226	13.24%	0.00%
PC P-36:4; PC 35:5	766.5382	13.25%	0.00%
PC O-36:5/P-36:4	766.5745	0.00%	0.00%
PC P-36:3; PC 35:4	768.5538	13.26%	0.00%
PC O-36:4/P-36:3	768.5902	13.26%	0.00%
PC P-36:2; PC 35:3	770.5694	13.27%	0.00%
PC O-36:3/P-36:2	770.6058	13.27%	0.00%
SM 39:2	771.6375	0.00%	49.20%
PC P-36:1; PC 35:2	772.5851	13.29%	49.57%
SM 39:1	773.6531	13.26%	49.23%
PC P-36:0; PC 35:1	774.6007	13.30%	49.59%
SM 39:0	775.6688	13.27%	49.25%
PC 36:7; PC O-36:0; PC 35:0	776.6164	13.31%	49.62%
PC 36:6; PC P-37:5	778.5381	13.45%	0.00%
PC 36:5; PC P-37:4	780.5538	13.46%	0.00%
PC 36:4; PC P-37:3	782.5694	13.48%	0.00%

SM 40:3	783.6375	0.00%	49.20%
PC 36:3; PC P-37:2	784.5851	13.49%	50.65%
SM 40:2	785.6531	13.80%	49.22%
PC 36:2; PC P-37:1	786.6007	13.50%	50.67%
SM 40:1	787.6688	13.81%	49.24%
PC 36:1; PC P-37:0	788.6164	13.51%	50.70%
SM 40:0	789.6844	13.82%	49.26%
PC 36:0; PC P-38:6	790.6320	13.52%	50.72%
PC P-38:5; PC 37:6	792.5532	14.34%	0.00%
PC O-38:6/P-38:5	792.5902	0.00%	0.00%
PC P-38:4; PC 37:5	794.5689	14.35%	0.00%
PC O-38:5/P-38:4	794.6058	14.35%	0.00%
PC P-38:3; PC 37:4	796.5845	14.36%	0.00%
PC O-38:4/P-38:3	796.6215	14.36%	0.00%
PC P-38:2; PC 37:3	798.6007	14.37%	0.00%
SM 41:2	799.6688	0.00%	51.41%
PC P-38:1; PC 37:2	800.6164	14.39%	51.78%
SM 41:1	801.6844	14.37%	51.44%
PC P-38:0; PC 37:1	802.6320	14.40%	51.80%
SM 41:0	803.7001	14.38%	51.46%
PC 38:7	804.5538	0.00%	0.00%
PC 38:7; PC O-38:0; PC 37:0	804.6477	14.41%	51.82%
PC 38:6; PC P-39:5	806.5695	14.55%	0.00%
PC 38:5; PC P-39:4	808.5852	14.56%	0.00%
PC 38:4; PC P-40:10; PC P-29:3	810.6007	14.57%	0.00%
SM d42:3	811.6688	0.00%	0.00%
PC 38:3; PC P-40:9; PC P-39:2	812.6164	14.59%	0.00%
SM 42:2	813.6844	0.00%	51.43%
PC 38:2; PC P-40:8; PC P-39:1	814.6320	14.60%	52.88%
SM 42:1	815.7001	14.94%	51.45%
PC 38:1; PC P-40:7; PC P-39:0	816.6477	14.61%	52.91%
SM 42:0	817.7157	14.95%	51.47%
PC O-40:7/P-40:6	818.6058	0.00%	0.00%
PC 38:0; PC P-40:6; PC O-39:0	818.6633	14.62%	52.93%
PC P-40:5; PC 39:6	820.5852	15.48%	0.00%
PC O-40:6/P-40:5	820.6215	15.48%	0.00%
PC P-40:4; PC 39:5	822.6008	15.50%	0.00%
PC O-40:5/P-40:4	822.6371	15.50%	0.00%
PC P-40:3; PC 39:4	824.6164	15.51%	0.00%
PC O-40:4/P-40:3	824.6528	15.51%	0.00%
PC 40:10; PC P-40:2; PC 39:3	826.5382	15.52%	0.00%
PC O-40:3/P-40:2	826.6684	15.52%	0.00%
SM 43:2	827.7001	0.00%	53.48%
PC 40:9; PC P-40:1; PC 39:2	828.5539	15.66%	53.99%
PC O-40:2/P-40:1	828.6841	15.53%	0.00%
SM 43:1	829.7157	15.52%	53.50%
PC 40:8; PC P-40:0; PC 39:1	830.5695	15.67%	54.01%
PC O-40:1/P-40:0	830.6997	15.55%	0.00%
SM 43:0	831.7314	15.54%	53.52%
PC 40:7; PC O-40:0; PC 39:0	832.5851	15.69%	54.03%
PC 40:6; PC P-41:5	834.6007	15.70%	0.00%
PC 40:5; PC P-41:4	836.6165	15.71%	0.00%
PC 40:4; PC P-42:10; PC P-41:3	838.6321	15.72%	0.00%
SM d44:3	839.7001	0.00%	0.00%
PC 40:3; PC P-42:9; PC P-41:2	840.6478	15.73%	0.00%
SM 44:2	841.7157	0.00%	55.67%
PC 40:2; PC P-42:8; PC P-41:1	842.6633	15.75%	55.09%
SM 44:1	843.7314	16.12%	55.69%
PC 40:1; PC P-42:7; PC P-41:0	844.6790	15.76%	55.11%
SM 44:0	845.7470	16.13%	55.72%
PC 40:0; PC P-42:6; PC O-41:0	846.6946	15.77%	55.14%

PC P-42:5; PC 41:6	848.6164	16.68%	0.00%
PC O-42:6/P-42:5	848.6528	0.00%	0.00%
PC P-42:4; PC 41:5	850.6321	16.69%	0.00%
PC O-42:5/P-42:4	850.6684	16.69%	0.00%
PC P-42:3; PC 41:4	852.6477	16.71%	0.00%
PC O-42:4/P-42:3	852.6841	16.71%	0.00%
PC 42:10; PC P-42:2; PC 41:3	854.5695	16.72%	0.00%
PC O-42:3/P-42:2	854.6997	16.72%	0.00%
PC 42:9; PC P-42:1; PC 41:2	856.5852	16.85%	0.00%
PC O-42:2/P-42:1	856.7154	16.73%	0.00%
PC 42:8; PC P-42:0; PC 41:1	858.6008	16.87%	0.00%
PC 42:7; PC O-42:0	860.6164	16.88%	0.00%
PC 42:6; PC P-43:5	862.6320	16.89%	0.00%
PC 42:5; PC P-43:4	864.6477	16.91%	0.00%
PC 42:4; PC P-43:3	866.6633	16.92%	0.00%
PC 42:3; PC P-43:2	868.6790	16.93%	0.00%
PC 42:2; PC P-43:1	870.6946	16.94%	0.00%
PC 42:1; PC P-43:0	872.7103	16.96%	0.00%
PC 42:0; PC O-43:0	874.7259	16.97%	0.00%
PC O-44:6/P-44:5	876.6841	0.00%	0.00%
PC O-44:5/P-44:4	878.6997	17.94%	0.00%
PC O-44:4/P-44:3	880.7154	17.95%	0.00%
PC 44:0	902.7573	0.00%	0.00%
Sulfatide 30:2	722.4473	0.00%	0.00%
Sulfatide 30:1	724.4630	15.10%	0.00%
Sulfatide 30:0	726.4786	15.11%	0.00%
Sulfatide 31:2	736.4630	0.00%	0.00%
Sulfatide 31:1; Sulfatide 30:2 (1OH)	738.4786	15.55%	0.00%
Sulfatide 31:0; Sulfatide 30:1 (1OH)	740.4943	15.56%	0.00%
Sulfatide 30:0 (1OH)	742.4735	15.57%	0.00%
Sulfatide 32:2	750.4786	0.00%	0.00%
Sulfatide 32:1; Sulfatide 31:2 (1OH)	752.4946	16.02%	0.00%
Sulfatide 32:0; Sulfatide 31:1 (1OH)	754.5099	16.03%	0.00%
Sulfatide 31:0 (1OH)	756.4892	16.04%	0.00%
Sulfatide 33:2	764.4943	0.00%	0.00%
Sulfatide 33:1; Sulfatide 32:2 (1OH)	766.5099	16.50%	0.00%
Sulfatide 33:0; Sulfatide 32:1 (1OH)	768.5255	16.51%	0.00%
Sulfatide 32:0 (1OH)	770.5048	16.52%	0.00%
Sulfatide 34:2	778.5099	0.00%	0.00%
Sulfatide 34:1; Sulfatide 33:2 (1OH)	780.5255	17.00%	0.00%
Sulfatide 34:0; Sulfatide 33:1 (1OH)	782.5412	17.01%	0.00%
Sulfatide 33:0 (1OH)	784.5205	17.02%	0.00%
Sulfatide 35:2	792.5255	0.00%	0.00%
Sulfatide 35:1; Sulfatide 34:2 (1OH)	794.5412	17.50%	0.00%
Sulfatide 35:0; Sulfatide 34:1 (1OH)	796.5569	17.51%	0.00%
Sulfatide 34:0 (1OH)	798.5361	17.52%	0.00%
Sulfatide 36:2	806.5412	0.00%	0.00%
Sulfatide 36:1; Sulfatide 35:2 (1OH)	808.5569	18.02%	0.00%
Sulfatide 36:0; Sulfatide 35:1 (1OH)	810.5725	18.03%	0.00%
Sulfatide 35:0 (1OH)	812.5518	18.05%	0.00%
Sulfatide 37:2	820.5569	0.00%	0.00%
Sulfatide 37:1; Sulfatide 36:2 (1OH)	822.5725	18.55%	0.00%
Sulfatide 37:0; Sulfatide 36:1 (1OH)	824.5882	18.56%	0.00%
Sulfatide 36:0 (1OH)	826.5674	18.57%	0.00%
Sulfatide 38:3	832.5569	0.00%	0.00%
Sulfatide 38:2	834.5725	19.08%	0.00%
Sulfatide 38:1; Sulfatide 37:2 (1OH)	836.5882	19.09%	0.00%
Sulfatide 38:0; Sulfatide 37:1 (1OH)	838.6038	19.10%	0.00%
Sulfatide 37:0 (1OH)	840.5831	19.11%	0.00%
Sulfatide 39:2; Sulfatide 38:3 (1OH)	848.5882	0.00%	0.00%
Sulfatide 39:1; Sulfatide 38:2 (1OH)	850.6038	19.65%	0.00%

Sulfatide 39:0; Sulfatide 38:1 (1OH)	852.6195	19.66%	0.00%
Sulfatide 38:0 (1OH)	854.5987	19.67%	0.00%
Sulfatide 40:3	860.5881	0.00%	0.00%
Sulfatide 40:2	862.6038	20.20%	0.00%
Sulfatide 40:1; Sulfatide 39:2 (1OH)	864.6195	20.22%	0.00%
Sulfatide 40:0; Sulfatide 39:1 (1OH)	866.6351	20.23%	0.00%
Sulfatide 39:0 (1OH)	868.6144	20.24%	0.00%
Sulfatide 41:2; Sulfatide 40:3 (1OH)	876.6195	0.00%	0.00%
Sulfatide 41:1; Sulfatide 40:2 (1OH)	878.6351	20.79%	0.00%
Sulfatide 41:0; Sulfatide 40:1 (1OH)	880.6508	20.80%	0.00%
Sulfatide 40:0 (1OH)	882.6300	20.81%	0.00%
Sulfatide 42:3	888.6195	0.00%	0.00%
Sulfatide 42:2	890.6351	21.37%	0.00%
Sulfatide 42:1; Sulfatide 41:2 (1OH)	892.6508	21.38%	0.00%
Sulfatide 42:0; Sulfatide 41:1 (1OH)	894.6664	21.40%	0.00%
Sulfatide 41:0 (1OH)	896.6457	21.41%	0.00%
Sulfatide 43:2; Sulfatide 42:3 (1OH)	904.6508	0.00%	0.00%
Sulfatide 43:1; Sulfatide 42:2 (1OH)	906.6664	21.98%	0.00%
Sulfatide 43:0; Sulfatide 42:1 (1OH)	908.6821	22.00%	0.00%
Sulfatide 42:0 (1OH)	910.6613	22.01%	0.00%
Sulfatide 44:3	916.6508	0.00%	0.00%
Sulfatide 44:2	918.6664	22.59%	0.00%
Sulfatide 44:1; Sulfatide 43:2 (1OH)	920.6821	22.60%	0.00%
Sulfatide 44:0; Sulfatide 43:1 (1OH)	922.6977	22.62%	0.00%
Sulfatide 43:0 (1OH)	924.6770	22.63%	0.00%
LPA 6:0	288.1206	0.00%	0.00%
LPA 8:0	316.1519	0.00%	0.00%
LPA 10:0	344.1832	0.00%	0.00%
LPA 12:0	372.2145	0.00%	0.00%
LPA 14:0 (IS)	400.2458	0.00%	0.00%
LPA P-16:0; LPA O-16:1	412.2822	0.00%	0.00%
LPA O-16:0; LPA 15:0	414.2615	3.46%	0.00%
LPA 16:2	424.2458	0.00%	0.00%
LPA 16:1	426.2615	3.67%	0.00%
LPA 16:0	428.2771	3.67%	0.00%
LPA P-18:0; LPA O-18:1; LPA 17:1	440.3140	0.00%	0.00%
LPA O-18:0; LPA 17:0	442.2928	3.95%	0.00%
LPA 18:4	448.2458	0.00%	0.00%
LPA 18:3	450.2615	4.15%	0.00%
LPA 18:2	452.2771	4.15%	0.00%
LPA 18:1	454.2928	4.16%	0.00%
LPA 18:0	456.3084	4.16%	0.00%
LPA P-20:0; LPA O-20:1	468.3448	0.00%	0.00%
LPA O-20:0; LPA 19:0	470.3241	4.49%	0.00%
LPA 20:5	474.2609	0.00%	0.00%
LPA 20:4	476.2766	4.68%	0.00%
LPA 20:3	478.2922	4.69%	0.00%
LPA 20:2	480.3084	4.69%	0.00%
LPA 20:1	482.3241	4.70%	0.00%
LPA 20:0	484.3397	4.70%	0.00%
LPA P-22:0; LPA O-22:1	496.3761	0.00%	0.00%
LPA O-22:0; LPA 21:0	498.3554	5.08%	0.00%
LPA 22:6	500.2771	5.09%	0.00%
LPA 22:5	502.2922	5.26%	0.00%
LPA 22:4	504.3078	5.27%	0.00%
LPA 22:1	510.3554	0.00%	0.00%
LPA 22:0	512.3710	5.29%	0.00%
LPA P-24:0; LPA O-24:1	524.4074	0.00%	0.00%
LPA O-24:0; LPA 23:0	526.3867	5.72%	0.00%
LPA 24:1	538.3867	0.00%	0.00%
LPA 24:0	540.4023	5.93%	0.00%

LPA 25:0	554.4180	0.00%	0.00%
LPA 26:0	568.4336	0.00%	0.00%
LPA 27:0	582.4493	0.00%	0.00%
LPA 28:0	596.4649	0.00%	0.00%
PA 28:0 (IS)	610.4442	0.00%	0.00%
PA 29:0	624.4598	0.00%	0.00%
PA 30:1	636.4598	0.00%	0.00%
PA 30:0	638.4755	8.35%	0.00%
PA P-32:1; PA-31:2	648.4962	0.00%	0.00%
PA P-32:0; PA-31:1	650.4755	8.96%	0.00%
PA O-32:0; PA-31:0	652.4911	8.97%	0.00%
PA 32:3; PA P-33:2	660.4598	0.00%	0.00%
PA 32:2; PA P-33:1	662.4755	9.16%	0.00%
PA 32:1; PA P-33:0	664.4911	9.17%	0.00%
PA 32:0; PA O-33:0	666.5068	9.18%	0.00%
PA P-34:1; PA 33:2	676.4911	0.00%	0.00%
PA P-34:0; PA 33:1	678.5068	9.84%	0.00%
PA O-34:0; PA 33:0	680.5224	9.85%	0.00%
PA 34:4; PA P-35:3	686.4755	0.00%	0.00%
PA 34:3; PA P-35:2	688.4911	10.03%	0.00%
PA 34:2; PA P-35:1	690.5068	10.04%	0.00%
PA 34:1; PA P-35:0	692.5224	10.05%	0.00%
PA 34:0; PA P-36:6	694.5381	10.06%	0.00%
PA P-36:5; PA 35:6	696.4599	10.72%	0.00%
PA P-36:4; PA 35:5	698.4755	10.73%	0.00%
PA P-36:3; PA 35:4	700.4911	10.74%	0.00%
PA P-36:2; PA 35:3	702.5068	10.75%	0.00%
PA P-36:1; PA 35:2	704.5224	10.76%	0.00%
PA P-36:0; PA 35:1	706.5381	10.77%	0.00%
PA 36:7; PA O-36:0; PA 35:0	708.5537	10.79%	0.00%
PA 36:6; PA P-37:5	710.4755	10.93%	0.00%
PA 36:5; PA P-37:4	712.4911	10.94%	0.00%
PA 36:4; PA P-37:3	714.5068	10.95%	0.00%
PA 36:3; PA P-37:2	716.5224	10.97%	0.00%
PA 36:2; PA P-37:1	718.5381	10.98%	0.00%
PA 36:1; PA P-37:0	720.5537	10.99%	0.00%
PA 36:0; PA P-38:6	722.5694	11.00%	0.00%
PA P-38:5; PA 37:6	724.4905	11.70%	0.00%
PA P-38:4; PA 37:5	726.5062	11.71%	0.00%
PA P-38:3; PA 37:4	728.5218	11.72%	0.00%
PA P-38:2; PA 37:3	730.5381	11.73%	0.00%
PA P-38:1; PA 37:2	732.5537	11.74%	0.00%
PA P-38:0; PA 37:1	734.5694	11.75%	0.00%
PA 38:7; PA O-38:0; PA 37:0	736.5850	11.76%	0.00%
PA 38:6; PA P-39:5	738.5068	11.91%	0.00%
PA 38:5; PA P-39:4	740.5225	11.92%	0.00%
PA 38:4; PA P-40:10; PA P-29:3	742.5381	11.93%	0.00%
PA 38:3; PA P-40:9; PA P-39:2	744.5537	11.941%	0.00%
PA 38:2; PA P-40:8; PA P-39:1	746.5694	11.95%	0.00%
PA 38:1; PA P-40:7; PA P-39:0	748.5850	11.97%	0.00%
PA 38:0; PA P-40:6; PA O-39:0	750.6007	11.98%	0.00%
PA P-40:5; PA 39:6	752.5225	12.72%	0.00%
PA P-40:4; PA 39:5	754.5381	12.73%	0.00%
PA P-40:3; PA 39:4	756.5537	12.74%	0.00%
PA 40:10; PA P-40:2; PA 39:3	758.4755	12.76%	0.00%
PA 40:9; PA P-40:1; PA 39:2	760.4912	12.90%	0.00%
PA 40:8; PA P-40:0; PA 39:1	762.5068	12.91%	0.00%
PA 40:7; PA O-40:0; PA 39:0	764.5224	12.92%	0.00%
PA 40:6; PA P-41:5	766.5381	12.93%	0.00%
PA 40:5; PA P-41:4	768.5538	12.95%	0.00%
PA 40:4; PA P-42:10; PA P-41:3	770.5694	12.96%	0.00%

PA 40:3; PA P-42:9; PA P-41:2	772.5851	12.97%	0.00%
PA 40:2; PA P-42:8; PA P-41:1	774.6007	12.98%	0.00%
PA 40:1; PA P-42:7; PA P-41:0	776.6163	12.99%	0.00%
PA 40:0; PA P-42:6; PA O-41:0	778.6320	13.01%	0.00%
PA P-42:5; PA 41:6	780.5537	13.79%	0.00%
PA P-42:4; PA 41:5	782.5694	13.81%	0.00%
PA P-42:3; PA 41:4	784.5850	13.82%	0.00%
PA 42:10; PA P-42:2; PA 41:3	786.5068	13.83%	0.00%
PA 42:9; PA P-42:1; PA 41:2	788.5225	13.97%	0.00%
PA 42:8; PA P-42:0; PA 41:1	790.5381	13.98%	0.00%
PA 42:7; PA O-42:0	792.5537	13.99%	0.00%
PA 42:6; PA P-43:5	794.5694	14.01%	0.00%
PA 42:5; PA P-43:4	796.5850	14.02%	0.00%
PA 42:4; PA P-43:3	798.6007	14.03%	0.00%
PA 42:3; PA P-43:2	800.6163	14.05%	0.00%
PA 42:2; PA P-43:1	802.6320	14.06%	0.00%
PA 42:1; PA P-43:0	804.6476	14.07%	0.00%
PA 42:0; PA O-43:0	806.6633	14.08%	0.00%
PA 44:0	834.6946	0.00%	0.00%
S1P d16:1	374.2067	0.00%	0.00%
S1P d16:0	376.2223	2.60%	0.00%
S1P d17:0	386.2067	0.00%	0.00%
S1P d17:1	388.2223	2.80%	0.00%
S1P d18:2	400.2223	0.00%	0.00%
S1P d18:1	402.2380	3.01%	0.00%
S1P d18:0	404.2536	3.02%	0.00%
S1P d19:1	414.2380	0.00%	0.00%
S1P d19:0	416.2531	3.24%	0.00%
S1P d20:1	430.2693	0.00%	0.00%
S1P d20:0	432.2849	3.48%	0.00%
LPS 6:0	358.1261	0.00%	0.00%
LPS 8:0	386.1574	0.00%	0.00%
LPS 10:0	414.1887	0.00%	0.00%
LPS 12:0	442.2200	0.00%	0.00%
LPS 14:0	470.2513	0.00%	0.00%
LPS P-16:0; LPS O-16:1	482.2877	0.00%	0.00%
LPS O-16:0; LPS 15:0	484.2670	4.64%	0.00%
LPS 16:2	494.2513	0.00%	0.00%
LPS 16:1	496.2670	4.84%	0.00%
LPS 16:0	498.2826	4.85%	0.00%
LPS P-18:0; LPS O-18:1; LPS 17:1 (IS)	510.3196	0.00%	0.00%
LPS O-18:0; LPS 17:0	512.2983	5.20%	0.00%
LPS 18:4	518.2513	0.00%	0.00%
LPS 18:3	520.2670	5.39%	0.00%
LPS 18:2	522.2826	5.40%	0.00%
LPS 18:1	524.2983	5.40%	0.00%
LPS 18:0	526.3139	5.41%	0.00%
LPS P-20:0; LPS O-20:1	538.3503	0.00%	0.00%
LPS O-20:0; LPS 19:0	540.3296	5.81%	0.00%
LPS 20:5	544.2664	0.00%	0.00%
LPS 20:4	546.2821	6.00%	0.00%
LPS 20:3	548.2977	6.00%	0.00%
LPS 20:2	550.3139	6.01%	0.00%
LPS 20:1	552.3296	6.02%	0.00%
LPS 20:0	554.3452	6.02%	0.00%
LPS P-22:0; LPS O-22:1	566.3816	0.00%	0.00%
LPS O-22:0; LPS 21:0	568.3609	6.48%	0.00%
LPS 22:6	570.2826	6.48%	0.00%
LPS 22:5	572.2977	6.65%	0.00%
LPS 22:4	574.3133	6.66%	0.00%
LPS 22:1	580.3609	0.00%	0.00%

LPS 22:0	582.3765	6.69%	0.00%
LPS P-24:0; LPS O-24:1	594.4129	0.00%	0.00%
LPS O-24:0; LPS 23:0	596.3922	7.19%	0.00%
LPS 24:1	608.3922	0.00%	0.00%
LPS 24:0	610.4078	7.40%	0.00%
LPS 25:0	624.4235	0.00%	0.00%
LPS 26:0	638.4391	0.00%	0.00%
LPS 27:0	652.4548	0.00%	0.00%
LPS 28:0	666.4704	0.00%	0.00%
PS 28:0 (IS)	680.4497	0.00%	0.00%
PS 29:0	694.4653	0.00%	0.00%
PS 30:1	706.4653	0.00%	0.00%
PS 30:0	708.4810	10.04%	0.00%
PS P-32:1; PS-31:2	718.5017	0.00%	0.00%
PS P-32:0; PS-31:1	720.4810	10.72%	0.00%
PS O-32:0; PS-31:0	722.4966	10.73%	0.00%
PS 32:3; PS P-33:2	730.4653	0.00%	0.00%
PS 32:2; PS P-33:1	732.4810	10.92%	0.00%
PS 32:1; PS P-33:0	734.4966	10.93%	0.00%
PS 32:0; PS O-33:0	736.5123	10.94%	0.00%
PS P-34:1; PS 33:2	746.4966	0.00%	0.00%
PS P-34:0; PS 33:1	748.5123	11.68%	0.00%
PS O-34:0; PS 33:0	750.5279	11.69%	0.00%
PS 34:4; PS P-35:3	756.4810	0.00%	0.00%
PS 34:3; PS P-35:2	758.4966	11.87%	0.00%
PS 34:2; PS P-35:1	760.5123	11.88%	0.00%
PS 34:1; PS P-35:0	762.5279	11.89%	0.00%
PS 34:0; PS P-36:6	764.5436	11.90%	0.00%
PS P-36:5; PS 35:6	766.4654	12.67%	0.00%
PS P-36:4; PS 35:5	768.4810	12.64%	0.00%
PS P-36:3; PS 35:4	770.4966	12.65%	0.00%
PS P-36:2; PS 35:3	772.5123	12.66%	0.00%
PS P-36:1; PS 35:2	774.5279	12.67%	0.00%
PS P-36:0; PS 35:1	776.5436	12.68%	0.00%
PS 36:7; PS O-36:0; PS 35:0	778.5593	12.69%	0.00%
PS 36:6; PS P-37:5	780.4810	12.84%	0.00%
PS 36:5; PS P-37:4	782.4966	12.85%	0.00%
PS 36:4; PS P-37:3	784.5123	12.86%	0.00%
PS 36:3; PS P-37:2	786.5279	12.87%	0.00%
PS 36:2; PS P-37:1	788.5436	12.88%	0.00%
PS 36:1; PS P-37:0	790.5593	12.90%	0.00%
PS 36:0; PS P-38:6	792.5749	12.91%	0.00%
PS P-38:5; PS 37:6	794.4961	13.68%	0.00%
PS P-38:4; PS 37:5	796.5118	13.69%	0.00%
PS P-38:3; PS 37:4	798.5274	13.70%	0.00%
PS P-38:2; PS 37:3	800.5436	13.71%	0.00%
PS P-38:1; PS 37:2	802.5593	13.72%	0.00%
PS P-38:0; PS 37:1	804.5749	13.74%	0.00%
PS 38:7; PS O-38:0; PS 37:0	806.5906	13.75%	0.00%
PS 38:6; PS P-39:5	808.5123	13.89%	0.00%
PS 38:5; PS P-39:4	810.5280	13.90%	0.00%
PS 38:4; PS P-40:10; PS P-29:3	812.5436	13.91%	0.00%
PS 38:3; PS P-40:9; PS P-39:2	814.5593	13.925%	0.00%
PS 38:2; PS P-40:8; PS P-39:1	816.5749	13.94%	0.00%
PS 38:1; PS P-40:7; PS P-39:0	818.5906	13.95%	0.00%
PS 38:0; PS P-40:6; PS O-39:0	820.6062	13.96%	0.00%
PS P-40:5; PS 39:6	822.5280	14.78%	0.00%
PS P-40:4; PS 39:5	824.5436	14.79%	0.00%
PS P-40:3; PS 39:4	826.5593	14.80%	0.00%
PS 40:10; PS P-40:2; PS 39:3	828.4810	14.81%	0.00%
PS 40:9; PS P-40:1; PS 39:2	830.4967	14.95%	0.00%

PS 40:8; PS P-40:0; PS 39:1	832.5123	14.96%	0.00%
PS 40:7; PS O-40:0; PS 39:0	834.5279	14.98%	0.00%
PS 40:6; PS P-41:5	836.5436	14.99%	0.00%
PS 40:5; PS P-41:4	838.5593	15.00%	0.00%
PS 40:4; PS P-42:10; PS P-41:3	840.5749	15.01%	0.00%
PS 40:3; PS P-42:9; PS P-41:2	842.5906	15.03%	0.00%
PS 40:2; PS P-42:8; PS P-41:1	844.6062	15.04%	0.00%
PS 40:1; PS P-42:7; PS P-41:0	846.6219	15.05%	0.00%
PS 40:0; PS P-42:6; PS O-41:0	848.6375	15.06%	0.00%
PS P-42:5; PS 41:6	850.5593	15.92%	0.00%
PS P-42:4; PS 41:5	852.5749	15.94%	0.00%
PS P-42:3; PS 41:4	854.5906	15.95%	0.00%
PS 42:10; PS P-42:2; PS 41:3	856.5123	15.96%	0.00%
PS 42:9; PS P-42:1; PS 41:2	858.5280	16.10%	0.00%
PS 42:8; PS P-42:0; PS 41:1	860.5436	16.11%	0.00%
PS 42:7; PS O-42:0	862.5593	16.12%	0.00%
PS 42:6; PS P-43:5	864.5749	16.14%	0.00%
PS 42:5; PS P-43:4	866.5906	16.15%	0.00%
PS 42:4; PS P-43:3	868.6062	16.16%	0.00%
PS 42:3; PS P-43:2	870.6219	16.18%	0.00%
PS 42:2; PS P-43:1	872.6375	16.19%	0.00%
PS 42:1; PS P-43:0	874.6532	16.20%	0.00%
PS 42:0; PS O-43:0	876.6688	16.21%	0.00%
PS 44:0	904.7001	0.00%	0.00%
LPG 6:0	362.1574	0.00%	0.00%
LPG 8:0	390.1887	0.00%	0.00%
LPG 10:0	418.2200	0.00%	0.00%
LPG 12:0	446.2513	0.00%	0.00%
LPG 14:0 (IS)	474.2826	0.00%	0.00%
LPG P-16:0; LPG O-16:1	486.3190	0.00%	0.00%
LPG O-16:0; LPG 15:0	488.2983	4.65%	0.00%
LPG 16:2	498.2826	0.00%	0.00%
LPG 16:1	500.2983	4.85%	0.00%
LPG 16:0	502.3139	4.86%	0.00%
LPG P-18:0; LPG O-18:1; LPG 17:1	514.3508	0.00%	0.00%
LPG O-18:0; LPG 17:0	516.3296	5.21%	0.00%
LPG 18:4	522.2826	0.00%	0.00%
LPG 18:3	524.2983	5.40%	0.00%
LPG 18:2	526.3139	5.41%	0.00%
LPG 18:1	528.3296	5.42%	0.00%
LPG 18:0	530.3452	5.42%	0.00%
LPG P-20:0; LPG O-20:1	542.3816	0.00%	0.00%
LPG O-20:0; LPG 19:0	544.3609	5.83%	0.00%
LPG 20:5	548.2977	0.00%	0.00%
LPG 20:4	550.3134	6.01%	0.00%
LPG 20:3	552.3290	6.02%	0.00%
LPG 20:2	554.3452	6.02%	0.00%
LPG 20:1	556.3609	6.03%	0.00%
LPG 20:0	558.3765	6.04%	0.00%
LPG P-22:0; LPG O-22:1	570.4129	0.00%	0.00%
LPG O-22:0; LPG 21:0	572.3922	6.49%	0.00%
LPG 22:6	574.3139	6.50%	0.00%
LPG 22:5	576.3290	6.67%	0.00%
LPG 22:4	578.3446	6.67%	0.00%
LPG 22:1	584.3922	0.00%	0.00%
LPG 22:0	586.4078	6.70%	0.00%
LPG P-24:0; LPG O-24:1	598.4442	0.00%	0.00%
LPG O-24:0; LPG 23:0	600.4235	7.20%	0.00%
LPG 24:1	612.4235	0.00%	0.00%
LPG 24:0	614.4391	7.41%	0.00%
LPG 25:0	628.4548	0.00%	0.00%

LPG 26:0	642.4704	0.00%	0.00%
LPG 27:0	656.4861	0.00%	0.00%
LPG 28:0	670.5017	0.00%	0.00%
PG 28:0	684.4810	0.00%	0.00%
PG 29:0	698.4966	0.00%	0.00%
PG 30:1	710.4966	0.00%	0.00%
PG 30:0	712.5123	10.06%	0.00%
PG P-32:1; PG-31:2	722.5330	0.00%	0.00%
PG P-32:0; PG-31:1	724.5123	10.74%	0.00%
PG O-32:0; PG-31:0	726.5279	10.75%	0.00%
PG 32:3; PG P-33:2	734.4966	0.00%	0.00%
PG 32:2; PG P-33:1	736.5123	10.94%	0.00%
PG 32:1; PG P-33:0	738.5279	10.96%	0.00%
PG 32:0; PG O-33:0	740.5436	10.97%	0.00%
PG P-34:1; PG 33:2	750.5279	0.00%	0.00%
PG P-34:0; PG 33:1	752.5436	11.70%	0.00%
PG O-34:0; PG 33:0	754.5592	11.71%	0.00%
PG 34:4; PG P-35:3	760.5123	0.00%	0.00%
PG 34:3; PG P-35:2	762.5279	11.89%	0.00%
PG 34:2; PG P-35:1	764.5436	11.90%	0.00%
PG 34:1; PG P-35:0	766.5592	11.91%	0.00%
PG 34:0; PG P-36:6	768.5749	11.92%	0.00%
PG P-36:5; PG 35:6	770.4967	12.65%	0.00%
PG P-36:4; PG 35:5	772.5123	12.66%	0.00%
PG P-36:3; PG 35:4	774.5279	12.67%	0.00%
PG P-36:2; PG 35:3	776.5436	12.68%	0.00%
PG P-36:1; PG 35:2	778.5592	12.69%	0.00%
PG P-36:0; PG 35:1	780.5749	12.70%	0.00%
PG 36:7; PG O-36:0; PG 35:0	782.5905	12.72%	0.00%
PG 36:6; PG P-37:5	784.5123	12.86%	0.00%
PG 36:5; PG P-37:4	786.5279	12.87%	0.00%
PG 36:4; PG P-37:3	788.5436	12.88%	0.00%
PG 36:3; PG P-37:2	790.5592	12.90%	0.00%
PG 36:2; PG P-37:1	792.5749	12.91%	0.00%
PG 36:1; PG P-37:0	794.5905	12.92%	0.00%
PG 36:0; PG P-38:6	796.6062	12.93%	0.00%
PG P-38:5; PG 37:6	798.5273	13.70%	0.00%
PG P-38:4; PG 37:5	800.5430	13.71%	0.00%
PG P-38:3; PG 37:4	802.5586	13.72%	0.00%
PG P-38:2; PG 37:3	804.5749	13.73%	0.00%
PG P-38:1; PG 37:2	806.5905	13.75%	0.00%
PG P-38:0; PG 37:1	808.6062	13.76%	0.00%
PG 38:7; PG O-38:0; PG 37:0	810.6218	13.77%	0.00%
PG 38:6; PG P-39:5	812.5436	13.91%	0.00%
PG 38:5; PG P-39:4	814.5593	13.92%	0.00%
PG 38:4; PG P-40:10; PG P-29:3	816.5749	13.94%	0.00%
PG 38:3; PG P-40:9; PG P-39:2	818.5905	13.95%	0.00%
PG 38:2; PG P-40:8; PG P-39:1	820.6062	13.96%	0.00%
PG 38:1; PG P-40:7; PG P-39:0	822.6218	13.97%	0.00%
PG 38:0; PG P-40:6; PG O-39:0	824.6375	13.98%	0.00%
PG P-40:5; PG 39:6	826.5593	14.80%	0.00%
PG P-40:4; PG 39:5	828.5749	14.81%	0.00%
PG P-40:3; PG 39:4	830.5905	14.82%	0.00%
PG 40:10; PG P-40:2; PG 39:3	832.5123	14.84%	0.00%
PG 40:9; PG P-40:1; PG 39:2	834.5280	14.98%	0.00%
PG 40:8; PG P-40:0; PG 39:1	836.5436	14.99%	0.00%
PG 40:7; PG O-40:0; PG 39:0	838.5592	15.00%	0.00%
PG 40:6; PG P-41:5	840.5749	15.01%	0.00%
PG 40:5; PG P-41:4	842.5906	15.03%	0.00%
PG 40:4; PG P-42:10; PG P-41:3	844.6062	15.04%	0.00%
PG 40:3; PG P-42:9; PG P-41:2	846.6219	15.05%	0.00%

PG 40:2; PG P-42:8; PG P-41:1	848.6375	15.06%	0.00%
PG 40:1; PG P-42:7; PG P-41:0	850.6531	15.07%	0.00%
PG 40:0; PG P-42:6; PG O-41:0	852.6688	15.09%	0.00%
PG P-42:5; PG 41:6	854.5905	15.96%	0.00%
PG P-42:4; PG 41:5	856.6062	15.97%	0.00%
PG P-42:3; PG 41:4	858.6218	15.99%	0.00%
PG 42:10; PG P-42:2; PG 41:3	860.5436	16.00%	0.00%
PG 42:9; PG P-42:1; PG 41:2	862.5593	16.14%	0.00%
PG 42:8; PG P-42:0; PG 41:1	864.5749	16.15%	0.00%
PG 42:7; PG O-42:0	866.5905	16.16%	0.00%
PG 42:6; PG P-43:5	868.6062	16.17%	0.00%
PG 42:5; PG P-43:4	870.6218	16.19%	0.00%
PG 42:4; PG P-43:3	872.6375	16.20%	0.00%
PG 42:3; PG P-43:2	874.6531	16.21%	0.00%
PG 42:2; PG P-43:1	876.6688	16.23%	0.00%
PG 42:1; PG P-43:0	878.6844	16.24%	0.00%
PG 42:0; PG O-43:0	880.7001	16.25%	0.00%
PG 44:0	908.7314	0.00%	0.00%

* mass-to-charge (m/z) of $[M+H]^+$; $[M+Na]^+$; $[M+NH_4]^+$; or $[M+NH_4-H_2O]^+$ depending on individual lipid (sub)class.

- 5 Table 20. Database of lipid species monitored during the identification step in the negative-ion mode together with the calculation of isotopic correction for M+1 and M+2 isotopic peaks (so called deisotoping).

Lipid	m/z	Isotopic correction	
		M+2	M+1
SulfoHexCer 34:1	778.5145	0.00%	0.00%
SulfoHexCer 34:2 (OH)	792.4937	0.00%	0.00%
SulfoHexCer 35:1	792.5301	0.00%	0.00%
SulfoHexCer 34:1 (OH)	794.5094	17.5%	0.00%
SulfoHexCer 35:0	794.5458	17.5%	0.00%
SulfoHexCer 34:0 (OH)	796.5250	17.51%	0.00%
SulfoHexCer 36:2	804.5301	0.00%	0.00%
SulfoHexCer 36:1	806.5458	18%	0.00%
SulfoHexCer 36:2 (OH)	820.5250	0.00%	0.00%
SulfoHexCer 37:1	820.5614	0.00%	0.00%
SulfoHexCer 36:1 (OH)	822.5407	18.55%	0.00%
SulfoHexCer 38:2	832.5614	0.00%	0.00%
SulfoHexCer 38:1	834.5771	19.01%	0.00%
SulfoHexCer 39:1	848.5927	0.00%	0.00%
SulfoHexCer 38:1 (OH)	850.5720	19.65%	0.00%
SulfoHexCer 40:2	860.5927	0.00%	0.00%
SulfoHexCer 40:1	862.6084	20.19%	0.00%
SulfoHexCer 39:1 (OH)	864.5876	20.21%	0.00%
SulfoHexCer 41:2	874.6084	0.00%	0.00%
SulfoHexCer 40:2 (OH)	876.5876	20.78%	0.00%
SulfoHexCer 41:1	876.6240	20.78%	0.00%
SulfoHexCer 40:1 (OH)	878.6033	20.79%	0.00%
SulfoHexCer 40:0 (OH)	880.6189	20.44%	0.00%
SulfoHexCer 42:4	884.5927	0.00%	0.00%
SulfoHexCer 42:3	886.6084	21.34%	0.00%
SulfoHexCer 42:2	888.6240	21.35%	0.00%
SulfoHexCer 41:2 (OH)	890.6033	21.36%	0.00%
SulfoHexCer 42:1	890.6397	21.36%	0.00%
SulfoHexCer 41:1 (OH)	892.6189	21.37%	0.00%
SulfoHexCer 41:0 (OH)	894.6346	21.02%	0.00%

SulfoHexCer 40:0 (2OH)	896.6138	21.03%	0.00%
SulfoHexCer 42:3 (OH)	902.6033	0.00%	0.00%
SulfoHexCer 43:2	902.6397	0.00%	0.00%
SulfoHexCer 42:2 (OH)	904.6189	21.97%	0.00%
SulfoHexCer 43:1	904.6553	21.97%	0.00%
SulfoHexCer 42:1 (OH)	906.6346	21.98%	0.00%
SulfoHexCer 42:0 (OH)	908.6502	21.61%	0.00%
SulfoHexCer 41:0 (2OH)	910.6295	21.62%	0.00%
SulfoHexCer 44:3	914.6397	0.00%	0.00%
SulfoHexCer 44:2	916.6553	22.57%	0.00%
SulfoHexCer 43:2 (OH)	918.6346	22.58%	0.00%
SulfoHexCer 44:1	918.6710	22.58%	0.00%
SulfoHexCer 43:1 (OH)	920.6502	22.59%	0.00%
SulfoHexCer 42:1 (2OH)	922.6295	22.21%	0.00%
SulfoHexCer 43:0 (OH)	922.6659	22.21%	0.00%
SulfoHexCer 42:0 (2OH)	924.6451	22.22%	0.00%
SulfoHexCer 44:2(OH)	932.6502	0.00%	0.00%
SulfoHexCer 44:1(OH)	934.6659	22.81%	0.00%
SulfoHexCer 43:1 (2OH)	936.6451	22.82%	0.00%
SulfoHexCer 44:0 (OH)	936.6815	22.82%	0.00%
SulfoHexCer 43:0 (2OH)	938.6608	22.83%	0.00%
SulfoHex ₂ Cer 32:1	912.5360	0.00%	0.00%
SulfoHex ₂ Cer 33:1	926.5516	0.00%	0.00%
SulfoHex ₂ Cer 34:2	938.5516	0.00%	0.00%
SulfoHex ₂ Cer 34:1	940.5673	21.31%	0.00%
SulfoHex ₂ Cer 35:1	954.5829	0.00%	0.00%
SulfoHex ₂ Cer 34:1 (OH)	956.5622	21.9%	0.00%
SulfoHex ₂ Cer 36:2	966.5829	21.9%	0.00%
SulfoHex ₂ Cer 36:1	968.5986	22%	0.00%
SulfoHex ₂ Cer 37:1	982.6142	0.00%	0.00%
SulfoHex ₂ Cer 36:1 (OH)	984.5935	23.1%	0.00%
SulfoHex ₂ Cer 38:2	994.6142	0.00%	0.00%
SulfoHex ₂ Cer 38:1	996.6299	23.71%	0.00%
SulfoHex ₂ Cer 39:1	1010.6455	0.00%	0.00%
SulfoHex ₂ Cer 38:1 (OH)	1012.6248	24.35%	0.00%
SulfoHex ₂ Cer 40:3	1020.6299	0.00%	0.00%
SulfoHex ₂ Cer 40:2	1022.6455	24.96%	0.00%
SulfoHex ₂ Cer 40:1	1024.6612	24.97%	0.00%
SulfoHex ₂ Cer 41:3	1034.6455	24.97%	0.00%
SulfoHex ₂ Cer 41:2	1036.6612	24.98%	0.00%
SulfoHex ₂ Cer 40:2 (OH)	1038.6404	24.99%	0.00%
SulfoHex ₂ Cer 41:1	1038.6768	24.99%	0.00%
SulfoHex ₂ Cer 40:1 (OH)	1040.6561	25%	0.00%
SulfoHex ₂ Cer 40:0 (OH)	1042.6717	25.1%	0.00%
SulfoHex ₂ Cer 42:4	1046.6455	0.00%	0.00%
SulfoHex ₂ Cer 42:3	1048.6612	26.27%	0.00%
SulfoHex ₂ Cer 42:2	1050.6768	26.28%	0.00%
SulfoHex ₂ Cer 42:1	1052.6925	26.28%	0.00%
SulfoHex ₂ Cer 42:3 (OH)	1064.6561	0.00%	0.00%
SulfoHex ₂ Cer 43:2	1064.6925	0.00%	0.00%
SulfoHex ₂ Cer 42:2 (OH)	1066.6717	26.98%	0.00%
SulfoHex ₂ Cer 43:1	1066.7081	26.98%	0.00%
SulfoHex ₂ Cer 42:1 (OH)	1068.6874	26.99%	0.00%
SulfoHex ₂ Cer 42:0 (OH)	1070.7030	27%	0.00%
SulfoHex ₂ Cer 44:4	1074.6770	0.00%	0.00%
SulfoHex ₂ Cer 44:3	1076.6925	27.63%	0.00%
SulfoHex ₂ Cer 44:2	1078.7081	27.64%	0.00%
SulfoHex ₂ Cer 43:2 (OH)	1080.6874	27.65%	0.00%
SulfoHex ₂ Cer 44:1	1080.7238	27.65%	0.00%
SulfoHex ₂ Cer 42:1 (2*OH)	1084.6823	0.00%	0.00%
SulfoHex ₂ Cer 44:2 (OH)	1094.7030	0.00%	0.00%

SulfoHexNAcHex2Cer 34:1	1143.6467	0.00%	0.00%
SulfoHexNAcHex2Cer 38:1	1199.7093	0.00%	0.00%
SulfoHexNAcHex2Cer 40:2	1225.7249	0.00%	0.00%
SulfoHexNAcHex2Cer 40:1	1227.7406	31.93%	0.00%
SulfoHexNAcHex2Cer 41:2	1239.7406	0.00%	0.00%
SulfoHexNAcHex2Cer 41:1	1241.7562	32.69%	0.00%
SulfoHexNAcHex2Cer 42:4	1249.7249	0.00%	0.00%
SulfoHexNAcHex2Cer 42:3	1251.7406	33.43%	0.00%
SulfoHexNAcHex2Cer 42:2	1253.7562	33.44%	0.00%
SulfoHexNAcHex2Cer 42:1	1255.7719	33.45%	0.00%
SulfoHexNAcHex2Cer 44:3	1279.7719	0.00%	0.00%
SulfoHexNAcHex2Cer 44:2	1281.7875	0.00%	0.00%
SulfoHexNAcHex4Cer 38:1	1523.8149	0.00%	0.00%
SulfoHexNAcHex4Cer 40:2	1549.8306	0.00%	0.00%
SulfoHexNAcHex4Cer 40:1	1551.8462	44.15%	0.00%
SulfoHexNAcHex4Cer 41:2	1563.8462	0.00%	0.00%
SulfoHexNAcHex4Cer 41:1	1565.8619	45.05%	0.00%
SulfoHexNAcHex4Cer 42:3	1575.8462	0.00%	0.00%
SulfoHexNAcHex4Cer 42:2	1577.8618	45.95%	0.00%
SulfoHexNAcHex4Cer 42:1	1579.8775	45.97%	0.00%
SulfoHexNAcHex4Cer 42:2 (OH)	1593.8568	0.00%	0.00%
SulfoHexNAcHex4Cer 42:1 (OH)	1595.8724	46.2%	0.00%
SulfoHexNAcHex3Cer 40:1	1389.7934	0.00%	0.00%
SulfoHexNAcHex3Cer 42:2	1415.8090	0.00%	0.00%
SulfoHexNAcHex3Cer 42:1	1417.8246	39.48%	0.00%
SulfoHexNAcHex3Cer 42:2 (OH)	1431.8039	0.00%	0.00%
SulfoHexNAcHex3Cer 42:1 (OH)	1433.8196	39.72%	0.00%
GM3 32:1	1123.6746	0.00%	0.00%
GM3 34:2	1149.6902	0.00%	0.00%
GM3 34:1	1151.7059	24.68%	0.00%
GM3 34:1 (OH)	1167.7008	0.00%	0.00%
GM3 36:2	1177.7215	0.00%	0.00%
GM3 36:1	1179.7372	26.1%	0.00%
GM3 36:1 (OH)	1195.7321	0.00%	0.00%
GM3 38:2	1205.7528	0.00%	0.00%
GM3 38:1	1207.7685	27.6%	0.00%
GM3 38:1 (OH)	1223.7634	0.00%	0.00%
GM3 40:2	1233.7841	0.00%	0.00%
GM3 40:1	1235.7998	29.13%	0.00%
GM3 41:2	1247.7998	0.00%	0.00%
GM3 41:1	1249.8154	29.91%	0.00%
GM3 40:1 (OH)	1251.7947	29.93%	0.00%
GM3 40:0 (OH)	1253.8104	29.38%	0.00%
GM3 42:3	1259.7998	0.00%	0.00%
GM3 42:2	1261.8154	30.7%	0.00%
GM3 42:1	1263.8311	30.71%	0.00%
GM3 42:3 (OH)	1275.7947	0.00%	0.00%
GM3 42:2 (OH)	1277.8103	30.9%	0.00%
GM3 42:1 (OH)	1279.8260	30.95%	0.00%
PS 34:2	758.4977	0.00%	0.00%
PS 34:1	760.5134	11.88%	0.00%
PS 36:4	782.4977	0.00%	0.00%
PS 36:2	786.5290	0.00%	0.00%
PS 36:1	788.5447	12.88%	0.00%
PS 38:4	810.5290	0.00%	0.00%
PS 38:3	812.5447	13.91%	0.00%
LPI 16:0 (IS)	571.2889	0.00%	0.00%
LPI 18:1	597.3045	0.00%	0.00%
LPI 18:0	599.3202	6.87%	0.00%
LPI 20:4	619.2889	0.00%	0.00%
PI 32:1 (IS)	807.5029	0.00%	0.00%

PI 32:0	809.5185	12.88%	0.00%
PI 34:2	833.5185	0.00%	0.00%
PI 34:1	835.5342	13.89%	0.00%
PI 34:0	837.5498	13.9%	0.00%
PI 35:2	847.5342	0.00%	0.00%
PI 35:1	849.5498	14.42%	0.00%
PI 36:4	857.5185	0.00%	0.00%
PI 36:3	859.5342	14.94%	0.00%
PI 36:2	861.5498	14.95%	0.00%
PI 36:1	863.5655	14.96%	0.00%
PI 37:4	871.5342	0.00%	0.00%
PI 37:3	873.5498	15.49%	0.00%
PI 38:6	881.5185	0.00%	0.00%
PI 38:5	883.5342	16.03%	0.00%
PI 38:4	885.5498	16.05%	0.00%
PI 38:3	887.5655	16.06%	0.00%
PI 40:6	909.5498	0.00%	0.00%
PI 40:5	911.5655	17.2%	0.00%
PI 40:4	913.5811	17.21%	0.00%
PG 32:0 (IS)	721.5025	0.00%	0.00%
PG 34:4	741.4712	0.00%	0.00%
PG 34:3	743.4869	11.7%	0.00%
PG 34:2	745.5025	11.71%	0.00%
PG 34:1	747.5181	11.72%	0.00%
PG 35:1	761.5338	0.00%	0.00%
PG 36:4	769.5025	0.00%	0.00%
PG 36:3	771.5181	12.69%	0.00%
PG 36:2	773.5338	11.7%	0.00%
PG 36:1	775.5494	11.71%	0.00%
PG 38:5	795.5181	0.00%	0.00%
PG 38:4	797.5338	13.73%	0.00%

* mass-to-charge (m/z) of [M-H]⁺.

Statistical evaluation

Measured concentrations of individual lipids of all measured subjects are imported into a statistical software (e.g., SIMCA from Umetrics, Sweden). Proper transformation and scaling are chosen, typically logarithmic transformation and Pareto or UV scaling. The scaling and transformation are based on PCA analysis, where normal distribution of healthy and pancreatic cancer patients is desirable. PCA analysis is also used to find potential outliers, if so, the influence of the outlier on the model is tested (remove the outlier and check the model) and measurement methods are questioned. If a technical problem in case of outlier measurement is identified, then this measurement is removed from the data set. PCA method is used for finding other influential factors, such as gender or age. QC samples should cluster closely together in PCA analysis, typically close to the middle of the PCA graph.

The next step is the use of discrimination analysis (OPLS-DA) for the group separation of pancreatic cancer patients and healthy volunteers separately for males and females. The scaling and transformation is based on PCA results, but the final model has to be found. Models are fitted on all data together and also on separate strata for influential covariates. Different groups of lipids are used to build the model and to explore the influence on the healthy vs. cancer separation. The final model is chosen based on multiple factors as good fit (all known samples are correctly classified), on the model stability (no too influential observations), good prediction ability (by cross-validation performed automatically and then manually

with random groups of observations) and biological reasoning and resistance to removing unimportant lipids. The final models are used to identify unknown samples, and the sensitivity and specificity are estimated based on these predictions. For this purpose, the receiver operating characteristic (ROC) curves are plotted, and the area under curve (AUC) is calculated. The model is again tested for good prediction ability via the final classification. After this last validation of the model, the most dysregulated lipids are identified using the S-plot or the loading plot. The limits to identify the lipid as dysregulated may be, for example, the ones from the S-plot with p bigger than 0.1 and $pcorr$ bigger than 0.4. For these most dysregulated lipids, the box-plots comparing the average values in the group of pancreatic cancer and healthy volunteers for different strata are used to find exact biological interpretation.

Results of experiments:

The present invention allows to determine whether the tested patient suffers from cancer, i.e., to distinguish between a healthy person and a person suffering from a cancer. Furthermore, the present invention also allows to determine the specific type of the cancer (also referred to herein as a localization of the cancer). The determination of the specific type (or localization) of the cancer is typically done as a second step, after determination that the tested patient suffers from cancer.

Typically, the distinction between a healthy person and a person suffering from a cancer has a high sensitivity and a high specificity (above 80%, or even above 90%). The distinction between specific types of cancer usually has a lower sensitivity and specificity.

Example A: UHPSFC/MS lipidomic analysis of human plasma of cancer patients and healthy volunteers

Body fluid samples of various patients suffering from various types of cancer (kidney, prostate, and breast) and healthy volunteers were analyzed for their lipid profile using UHPSFC/MS. Generally, absolute and relative concentrations of the lipid species can be used to determine differences in samples of different health state. In the following, absolute concentrations were used for statistical analysis in order to visualize differences between sample groups and errors in sample preparation or measurements. After centering, transformation and Pareto scaling, PCA of all samples were performed in order to identify outliers and measurement errors.

Figure 1 shows the results of the PCA analysis of 170 samples of healthy volunteers, 282 samples of patients suffering from cancer and 38 samples of unknown classification.

If unsupervised PCA does not show any significant clustering according to undesirable parameters (e.g., day of analysis) and unexplained outliers, then supervised OPLS-DA analysis is performed to improve the statistical model applicable also for predictions. If unwanted clustering or outliers are identified, then further investigations are necessary to identify the reason of those.

For OPLS-DA analysis, samples have to be defined according to their classification, i.e., groups of non-cancerous and cancerous samples. OPLS-DA analysis allows the visualization of differences between sample groups. It is preferred to have a clear differentiation, which means a gap between both groups.

However, it may happen that there is a small overlay of both groups, as differences in the lipid pattern in biological fluids are not large enough due to the biological variability of samples or the investigated cancer type does not show a sufficiently large difference in the lipid profile measured in the biological fluid. Generally, it is expected that depending on the cancer type as well as cancer stage, the extent of differences in the lipid profile is altered.

Figure 2 shows the OPLS-DA analysis of healthy (N, blue) and cancer samples (T) for both genders.

Figure 2 shows that non-cancerous and cancerous samples can be differentiated. However, there is a certain region of overlap of both sample types with false positives and false negatives, which must be always expected in the analysis of real-life biological samples. In order to see the lipid species responsible for differentiation, an S-plot is prepared (Figure 3). The S-plot allows the visualization of the most up- (upper right corner of the graph) and down- (bottom left corner) regulated lipid species for all investigated samples.

The prediction of the model encounters all components building up the model not only the most abundant once shown in the OPLS-DA plot.

The sensitivity describes the prediction power of the model to correctly predict samples as cancerous samples, whereby the specificity describes the correctly healthy predicted samples. For instance for the OPLS-DA model including healthy and cancer samples for all genders: in total 282 cancer samples are included and from those 252 samples were predicted as cancer samples whereas 30 samples were predicted as healthy samples, which leads to a sensitivity of 89.4%. 170 healthy samples are included in the model, and 137 samples were predicted as healthy, whereby 33 samples as cancer samples, which corresponds to a specificity of 80.6 %. The sensitivity as well as the specificity may improve, when the statistical analysis is performed for both genders separately and for each cancer type separately. Figure 4 shows the OPLS-DA plot for non-cancerous and cancerous samples for males and various cancer types

The statistical analysis of male samples for various cancer types gives the sensitivity of 93.0% and the specificity of 81.3%.

Compared to results for both genders, the sensitivity increases from 89.4 to 93.0% and specificity increases from 80.6 to 81.3%.

The statistical analysis of each cancer type separately in comparison to healthy samples may improve the sensitivity and specificity. For example, Figure 5 shows the OPLS-DA plot for the analysis of samples of non-cancerous and cancerous samples suffering from breast cancer for males.

The differentiation of non-cancerous and cancerous subjects suffering from breast cancer for males is pronounced. However, one has to keep in mind that just a very small amount of breast cancer samples for males are included in the model, as we did not get more samples provided from the hospital. The sensitivity and specificity is 100 %.

Figure 6 shows the OPLS-DA plot for the analysis of non-cancerous and cancerous samples suffering from prostate cancer for males. The sensitivity for the analysis of prostate cancer is 86.6 % and the specificity is 94.7 %.

Figure 7 shows the OPLS-DA plot for the analysis of non-cancerous and cancerous samples suffering from kidney cancer for males. The sensitivity for the analysis of kidney cancer samples from males is 90.1% and the specificity is 90.7%.

Figure 8 shows the OPLS-DA plot for the analysis of non-cancerous and cancerous samples for females.

- 5 The sensitivity for the analysis of healthy and cancer samples from females is 88.0 % and the specificity is 87.4%.

Figure 9 represents the OPLS-DA plot for the analysis of non-cancerous and cancerous samples suffering from breast cancer samples for females. The sensitivity is 87.2% and the specificity is 93.7% for the analysis of breast cancer samples from females.

- 10 Figure 10 represents the OPLS-DA plot for the analysis of non-cancerous and cancerous samples suffering from kidney cancer for females. The sensitivity is 74.2 % and the specificity is 100% for the analysis of kidney cancer samples from females.

- 15 Example B: MALDI-MS lipidomic analysis of body fluids (plasma, urine) of kidney cancer patients and healthy volunteers

- In this example, body fluid samples (plasma, urine) of various patients suffering from kidney cancer and healthy volunteers were analyzed for their lipid profile using MALDI-MS. In case of plasma samples, absolute concentrations (normalization to internal standard) were used for the statistical analysis in order
- 20 to visualize differences between sample groups and errors in sample preparation or measurements. On the contrary, relative concentrations were used for this purpose in case of urine samples. Illustrated statistical models for plasma samples include following 74 variables: SM 32:1, SM 33:1, SM 34:2, SM 34:1, SM 34:0, SM 35:1, SM 36:2, SM 36:1, SM 36:0, SM 37:1, SM 38:2, SM 38:1, SM 39:2, SM 39:1, SM 40:3, SM 40:2, SM 40:1, SM 41:3, SM 41:2, SM 41:1, SM 42:3, SM 42:2, SM 42:1, SM 43:3, SM 43:2, SM
- 25 43:1, Sul 32:1 (OH), Sul 34:2, Sul 34:1, Sul 34:2 (OH), Sul 34:1 (OH), Sul 34:0 (OH), Sul 36:1, Sul 36:1 (OH), Sul 38:2, Sul 38:1, Sul 38:2 (OH), Sul 38:1 (OH), Sul 40:2, Sul 40:1, Sul 41:2, Sul 40:2 (OH), Sul 41:1, Sul 40:1 (OH), Sul 40:0 (OH), Sul 42:3, Sul 42:2, Sul 41:2 (OH), Sul 42:1, Sul 41:1 (OH), Sul 40:0 (2OH), Sul 42:3 (OH), Sul 42:2 (OH), Sul 42:1 (OH), Sul 42:2 (2OH), Sul 42:1 (2OH), Sul 42:0 (2OH), SulfoHex2Cer 42:2, PI 32:1, PI 32:0, PI 34:2, PI 34:1, PI 36:4, PI 36:3, PI 36:2, PI 36:1, PI 38:6, PI 38:5,
- 30 PI 38:4, PI 38:3, PI 38:2, PI 40:6, PI 40:5, PI 40:4). Illustrated statistical models for urine samples include following 46 variables: hydroxypregnenolone sulfate, C21H34O7S sulfate, C21H34O8S sulfate, cortisol sulfate, lithocholic acid sulfate, cholesterol sulfate, glycochenodeoxycholic acid sulfate, tauroolithocholic acid, taurodeoxycholic acid, sulfoglycolithocholic acid, taurocholic acid, glycochenodeoxycholic acid sulfate, Sul 34:1, Sul 34:1 (OH), Sul 36:1 (OH), Sul 38:1, Sul 38:1 (OH), Sul 40:2, Sul 40:1, Sul 40:2
- 35 (OH), Sul 41:1, Sul 40:1 (OH), Sul 40:0 (OH), Sul 42:2, Sul 41:2 (OH), Sul 42:1, Sul 41:1 (OH), Sul 41:0 (OH), Sul 40:0 (2OH), Sul 42:2 (OH), Sul 42:1 (OH), Sul 42:0 (OH), Sul 41:0 (2OH), Sul 43:1 (OH), Sul 42:1 (2OH), Sul 42:0 (2OH), Sul 43:0 (2OH), SulfoHex2Cer 34:1, SulfoHex2Cer 38:1, SulfoHex2Cer

40:1, SulfoHex2Cer 40:1 (OH), SulfoHex2Cer 42:2, SulfoHex2Cer 42:1, SulfoHex2Cer 40:0 (2OH), SulfoHex2Cer 42:1 (OH), SulfoHex2Cer 42:0 (2OH).

Figure 11 shows the results of the PCA of 170 plasma samples of healthy volunteers (N), 111 plasma samples of patients suffering from kidney cancer (T) and 24 plasma samples of quality control pooled samples (Q) for both genders. Group separation between cancerous and healthy samples is evident even from unsupervised PCA model, but much better group separation is achieved using supervised OPLS-DA model illustrated in Figure 12, which provides sensitivity 76.6 %, specificity 95.3 % and accuracy 87.9 %. The sensitivity as well as the specificity is further improved, when the statistical analysis is performed for particular genders separately as illustrated in Figure 13 and 14. The statistical analysis of plasma samples of 80 patients suffering from kidney cancer and 75 healthy volunteers (control) gives the sensitivity 90 %, specificity 93.3 % (accuracy 91.6 %) in case of males. The statistical analysis of plasma samples of 32 patients suffering from kidney cancer and 95 healthy volunteers gives the sensitivity 83.9 %, specificity 98.9 % (accuracy 95.2 %) for females. Improvement of cancer prediction ability after gender separation is also observed for urine samples. Figure 15 shows the results of the PCA analysis of 70 urine samples of healthy volunteers (34 of males and 36 females), 101 urine samples of patients suffering from kidney cancer (72 of males and 29 of females) and 16 urine samples of quality control pooled samples (Q) for both genders. Corresponding OPLS-DA model for both genders is illustrated in Figure 16 and this model provides sensitivity 87.1 %, specificity 82.9 % (accuracy 85.4 %). Subsequent separation to models for individual genders results in sensitivity 93.1 %, specificity 91.2 % (accuracy 92.5 %) for males (Figure 17) and sensitivity 86.2 %, specificity 88.9 % (accuracy 87.7 %) for females (Figure 18).

Table 21. Statistical parameters for UHPSFC/MS analysis of non-cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for breast cancer.

Species	Fold change		P-value		T-value	
	F	M	F	M	F	M
TG 48:2	0.9	0.5	2.4E-01	3.2E-02	0.7	2.1
TG 50:3	0.9	0.7	2.0E-01	2.6E-02	0.8	2.2
TG 50:2	0.9	0.8	2.4E-01	9.1E-02	0.7	1.5
TG 51:4	0.8	0.7	6.5E-02	1.3E-01	1.5	1.3
TG 51:3	0.7	0.8	1.1E-03	1.1E-01	3.1	1.4
TG 51:2	0.7	0.8	4.6E-04	1.7E-01	3.4	1.0
TG 52:3	0.9	0.9	2.1E-01	1.7E-01	0.8	1.0
TG 53:4	0.8	0.8	1.5E-02	1.6E-01	2.2	1.1
TG 53:3	0.7	0.9	2.6E-04	3.8E-01	3.5	0.3
Cer40:1	0.5	0.5	1.0E-08	2.9E-04	5.9	4.3
Cer42:1	0.5	0.4	1.4E-10	2.5E-08	6.7	7.0
PC 32:2	0.5	0.3	6.3E-06	4.5E-08	4.5	6.8
PC 34:2	0.6	0.6	4.2E-10	1.5E-06	6.5	6.7
PC 34:1	0.6	0.7	9.8E-10	4.6E-03	6.3	3.2
PC O-36:4	0.5	0.3	7.6E-11	3.5E-09	6.8	8.2

PC O-36:3	0.5	0.4	1.6E-09	1.2E-11	6.3	8.6
PC 36:4	0.6	0.5	1.8E-10	1.3E-06	6.7	6.6
PC 36:3	0.6	0.5	1.6E-11	3.9E-11	7.1	9.4
PC 36:2	0.6	0.5	1.5E-09	4.2E-06	6.3	6.3
PC 38:6	0.6	0.5	3.0E-06	1.1E-04	4.7	4.5
PC 38:5	0.6	0.4	1.4E-07	6.6E-08	5.4	7.0
PC 38:4	0.7	0.6	1.6E-07	1.2E-03	5.3	4.0
PC 38:3	0.6	0.5	3.9E-05	1.2E-03	4.1	3.9
SM 34:2	0.6	0.5	1.6E-10	5.9E-05	6.7	5.4
SM 34:1	0.6	0.5	1.2E-09	3.0E-04	6.3	4.6
SM 36:2	0.6	0.6	5.0E-09	2.3E-03	6.0	3.6
SM 36:1	0.6	0.6	2.9E-08	6.4E-03	5.7	3.1
SM 38:2	0.6	0.6	2.1E-09	4.6E-04	6.2	4.1
SM 38:1	0.5	0.4	8.0E-13	9.9E-10	7.6	8.8
SM 40:2	0.5	0.4	1.1E-11	1.0E-07	7.2	7.6
SM 40:1	0.5	0.4	3.2E-12	8.8E-08	7.4	7.9
SM 41:2	0.5	0.4	2.6E-13	8.1E-06	7.8	6.0
SM 41:1	0.5	0.3	5.2E-14	3.6E-08	8.1	7.8
SM 42:3	0.6	0.6	2.1E-08	1.2E-03	5.8	3.9
SM 42:2	0.6	0.5	9.6E-08	3.2E-04	5.5	4.6
SM 42:1	0.3	0.1	1.2E-09	7.3E-15	6.4	9.5
LPC 16:0	0.6	0.3	1.3E-09	6.3E-12	6.3	12.1
LPC 18:2	0.5	0.2	3.9E-08	8.8E-18	5.6	12.2
LPC 18:1	0.5	0.2	3.0E-10	1.2E-18	6.6	12.3
LPC 18:0	0.5	0.2	3.1E-11	8.6E-16	7.0	14.1

Table 22. Statistical parameters for UHPSFC/MS analysis of non-cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for kidney cancer.

Species	Fold change		P-value		T-value	
	F	M	F	M	F	M
TG 48:2	0.4	0.5	1.0E-07	7.7E-04	5.5	3.3
TG 50:3	0.6	0.6	2.2E-07	4.9E-06	5.5	4.6
TG 50:2	0.6	0.6	1.0E-07	1.2E-04	5.6	3.8
TG 51:4	0.5	0.6	1.3E-05	1.6E-05	4.5	4.3
TG 51:3	0.6	0.6	9.4E-08	8.6E-07	5.8	5.1
TG 51:2	0.5	0.5	1.2E-08	1.0E-05	6.1	4.5
TG 52:3	0.7	0.7	1.3E-04	2.4E-06	3.9	4.8
TG 53:4	0.6	0.6	4.5E-05	2.3E-05	4.2	4.3
TG 53:3	0.6	0.6	9.8E-06	2.9E-05	4.6	4.2
Cer40:1	0.6	0.7	2.8E-04	3.4E-03	3.7	2.8
Cer42:1	0.5	0.6	1.0E-06	1.8E-04	5.3	3.7
PC 32:2	0.4	0.7	8.3E-07	1.1E-02	5.1	2.3
PC 34:2	0.6	0.7	7.6E-09	6.6E-07	6.7	5.1
PC 34:1	0.6	0.7	1.9E-06	4.0E-03	5.2	2.7
PC O-36:4	0.7	0.8	2.4E-03	2.0E-02	3.0	2.1
PC O-36:3	0.6	0.8	8.1E-06	6.4E-02	4.6	1.5

PC 36:4	0.7	0.7	1.6E-04	5.9E-04	3.9	3.3
PC 36:3	0.6	0.7	8.9E-08	3.3E-06	6.0	4.7
PC 36:2	0.6	0.6	6.7E-08	1.6E-07	6.1	5.4
PC 38:6	0.7	0.8	2.3E-02	7.4E-02	2.1	1.5
PC 38:5	0.7	0.7	1.2E-02	8.1E-03	2.4	2.4
PC 38:4	0.8	0.7	1.1E-02	3.0E-05	2.4	4.2
PC 38:3	0.7	0.7	4.7E-03	9.2E-05	2.7	3.9
SM 34:2	0.7	0.7	3.3E-03	1.3E-04	2.9	3.8
SM 34:1	0.6	0.6	2.6E-06	4.8E-09	5.1	6.1
SM 36:2	0.8	0.7	3.0E-02	1.9E-03	2.0	3.0
SM 36:1	0.8	0.7	6.9E-02	1.9E-03	1.5	3.0
SM 38:2	0.7	0.8	1.1E-02	1.8E-02	2.4	2.1
SM 38:1	0.6	0.6	4.7E-05	7.2E-06	4.3	4.5
SM 40:2	0.6	0.6	2.3E-04	1.2E-05	3.8	4.4
SM 40:1	0.6	0.6	1.0E-04	4.7E-07	4.1	5.2
SM 41:2	0.5	0.6	4.9E-06	4.6E-06	5.0	4.6
SM 41:1	0.5	0.5	3.5E-07	3.0E-08	5.6	5.7
SM 42:3	0.8	0.7	4.2E-02	4.3E-03	1.8	2.7
SM 42:2	0.7	0.6	3.7E-03	1.7E-05	2.9	4.3
SM 42:1	0.4	0.5	4.7E-05	2.3E-03	4.2	2.9
LPC 16:0	0.7	0.7	8.9E-03	4.9E-04	2.5	3.4
LPC 18:2	0.4	0.5	1.2E-08	8.7E-07	6.1	5.0
LPC 18:1	0.6	0.8	7.1E-04	2.3E-02	3.4	2.0
LPC 18:0	0.7	0.7	2.5E-02	3.4E-04	2.0	3.5

Table 23. Statistical parameters for UHPSFC/MS analysis of non-cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for prostate cancer.

Species	Fold change	P-value	T-value
	M	M	M
TG 48:2	0.6	7.6E-03	2.5
TG 50:3	0.7	3.0E-04	3.5
TG 50:2	0.7	1.2E-03	3.1
TG 51:4	0.7	3.3E-03	2.8
TG 51:3	0.7	1.4E-03	3.1
TG 51:2	0.7	3.6E-03	2.7
TG 52:3	0.7	4.5E-05	4.1
TG 53:4	0.7	4.3E-03	2.7
TG 53:3	0.7	3.4E-03	2.8
Cer40:1	0.5	3.6E-07	5.2
Cer42:1	0.5	2.0E-08	5.9
PC 32:2	0.6	1.2E-05	4.4
PC 34:2	0.6	1.3E-13	8.2
PC 34:1	0.6	1.1E-06	5.0
PC O-36:4	0.5	1.7E-08	5.9
PC O-36:3	0.6	6.2E-06	4.6

PC 36:4	0.6	8.5E-09	6.0
PC 36:3	0.6	7.3E-12	7.4
PC 36:2	0.6	1.1E-11	7.3
PC 38:6	0.7	1.5E-04	3.7
PC 38:5	0.7	1.3E-05	4.4
PC 38:4	0.6	1.9E-08	5.9
PC 38:3	0.6	8.7E-06	4.5
SM 34:2	0.5	4.5E-10	6.6
SM 34:1	0.5	1.3E-13	8.2
SM 36:2	0.6	1.5E-06	4.9
SM 36:1	0.6	2.4E-07	5.3
SM 38:2	0.6	2.5E-04	3.6
SM 38:1	0.5	5.2E-11	7.0
SM 40:2	0.5	1.4E-11	7.3
SM 40:1	0.4	5.4E-14	8.3
SM 41:2	0.4	6.7E-12	7.4
SM 41:1	0.4	1.0E-13	8.2
SM 42:3	0.5	6.4E-10	6.6
SM 42:2	0.5	2.1E-12	7.7
SM 42:1	0.3	1.2E-07	5.5
LPC 16:0	0.5	1.0E-15	9.0
LPC 18:2	0.4	1.6E-13	8.2
LPC 18:1	0.5	5.7E-11	7.0
LPC 18:0	0.5	3.2E-15	8.8

Table 24. Statistical parameters for MALDI-MS analysis of non- cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for breast cancer.

Species	Fold change		P-value		T-value	
	F	M	F	M	F	M
cholesterol sulfate	0.62	0.73	2.1E-09	6.8E-03	6.2	2.9
SM 32:1	0.57	0.50	1.5E-16	1.9E-06	9.0	7.5
SM 33:1	0.54	0.60	9.2E-18	1.3E-03	9.5	4.1
SM 34:2	0.66	0.71	1.3E-10	2.4E-03	6.7	3.5
SM 34:1	0.63	0.69	9.8E-15	6.9E-03	8.4	3.1
SM 34:0	0.60	0.55	3.6E-15	4.5E-04	8.6	4.8
SM 35:1	0.58	0.65	2.4E-14	3.0E-03	8.2	3.6
SM 36:1	0.67	0.70	2.7E-11	1.7E-02	7.0	2.6
SM 37:1	0.57	0.60	5.4E-15	2.9E-03	8.4	3.6
SM 38:2	0.65	0.64	1.6E-10	2.3E-04	6.7	4.6
SM 38:1	0.61	0.54	2.3E-16	4.4E-05	9.0	6.1
SM 39:2	0.54	0.58	5.8E-08	4.7E-04	5.6	4.3
SM 39:1	0.52	0.47	7.2E-18	3.0E-05	9.5	6.3
SM 40:3	0.52	0.67	4.2E-10	1.6E-02	6.5	2.5
SM 40:2	0.60	0.59	4.3E-15	4.1E-05	8.5	5.6
SM 40:1	0.60	0.54	5.4E-16	5.2E-05	8.9	6.0

SM 41:2	0.58	0.63	2.2E-15	1.1E-03	8.6	4.1
SM 41:1	0.58	0.53	4.4E-16	1.4E-04	8.9	5.5
SM 42:1	0.61	0.50	2.0E-14	7.5E-06	8.3	7.0
SM 43:1	0.41	0.32	5.4E-12	2.0E-07	7.5	6.7
Sul 34:2 (OH)	0.57	0.36	9.7E-09	1.0E-08	5.9	7.4
Sul 34:1 (OH)	0.63	0.54	8.8E-11	1.4E-05	6.8	5.8
Sul 34:0 (OH)	0.44	0.26	2.7E-13	5.6E-10	7.8	8.5
Sul 40:2	0.53	0.37	3.8E-08	4.2E-07	5.6	5.6
Sul 40:1	0.54	0.25	4.4E-11	2.3E-09	6.9	9.3
Sul 40:2 (OH)	0.58	0.34	1.5E-06	1.2E-07	4.8	6.4
Sul 41:1	0.48	0.34	3.3E-12	5.3E-13	7.4	8.6
Sul 40:1 (OH)	0.59	0.39	6.5E-11	3.8E-06	6.8	7.0
Sul 42:3	0.58	0.43	2.9E-07	1.5E-05	5.2	4.8
Sul 42:2	0.62	0.41	2.3E-10	1.1E-06	6.6	6.7
Sul 42:1	0.52	0.25	3.1E-12	6.3E-13	7.4	10.1
Sul 41:1 (OH)	0.54	0.34	4.2E-12	3.1E-06	7.3	7.0
Sul 42:1 (OH)	0.63	0.39	7.9E-11	2.6E-07	6.8	8.3
Sul 42:1 (2OH)	0.54	0.44	2.9E-07	1.2E-03	5.2	3.9
PI 34:1	0.61	0.62	1.9E-06	5.0E-03	4.8	3.2
PI 36:4	0.63	0.54	3.4E-06	1.6E-03	4.7	3.7
PI 36:3	0.64	0.51	2.0E-05	3.0E-05	4.2	5.0
PI 36:1	0.58	0.59	9.4E-09	6.9E-03	5.9	3.1
PI 38:5	0.58	0.51	9.1E-08	1.2E-03	5.5	3.9
PI 38:3	0.65	0.40	7.0E-07	9.2E-09	5.0	8.8

Table 25. Statistical parameters for MALDI-MS analysis of non-cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for kidney cancer.

Species	Fold change		P-value		T-value	
	F	M	F	M	F	M
cholesterol sulfate	0.57	0.80	5.1E-09	1.6E-02	6.3	2.2
SM 32:1	0.54	0.60	4.3E-10	1.4E-11	7.4	7.2
SM 33:1	0.57	0.63	1.4E-08	4.4E-10	6.6	6.6
SM 34:2	0.77	0.71	3.7E-03	6.7E-06	2.9	4.5
SM 34:1	0.72	0.75	3.4E-04	3.0E-05	3.7	4.2
SM 34:0	0.68	0.70	7.8E-05	1.2E-06	4.2	5.0
SM 35:1	0.64	0.66	1.1E-05	4.1E-08	4.8	5.7
SM 36:2	0.86	0.74	7.2E-02	1.8E-04	1.5	3.7
SM 36:1	0.81	0.74	1.5E-02	2.5E-05	2.3	4.2
SM 37:1	0.66	0.65	7.0E-05	1.1E-07	4.2	5.5
SM 38:2	0.76	0.69	2.7E-03	4.0E-06	3.0	4.7
SM 38:1	0.65	0.64	1.8E-05	9.9E-10	4.7	6.5
SM 39:1	0.52	0.53	3.4E-08	2.1E-14	6.4	8.4
SM 40:2	0.65	0.64	1.0E-05	2.2E-08	4.8	5.8
SM 40:1	0.65	0.63	2.5E-05	6.1E-10	4.6	6.5
SM 41:2	0.60	0.64	5.2E-07	1.3E-08	5.6	5.9
SM 41:1	0.58	0.59	1.3E-06	2.8E-12	5.5	7.5

SM 42:1	0.61	0.62	4.6E-06	9.0E-10	5.1	6.5
SM 43:3	0.65	0.75	2.1E-06	3.4E-05	5.0	4.1
SM 43:2	0.62	0.64	3.1E-05	2.9E-06	4.4	4.7
SM 43:1	0.39	0.39	8.2E-10	1.8E-11	6.6	7.4
Sul 32:1 (OH)	0.63	0.81	6.0E-07	6.9E-04	5.2	3.3
Sul 34:1	0.62	0.68	5.6E-05	2.0E-05	4.3	4.3
Sul 34:1 (OH)	0.61	0.68	1.6E-05	2.9E-05	4.7	4.2
Sul 34:0 (OH)	0.43	0.58	4.9E-08	3.5E-05	6.1	4.1
Sul 40:1	0.62	0.60	4.6E-04	1.1E-05	3.6	4.4
Sul 41:1	0.49	0.60	4.2E-07	2.7E-05	5.5	4.2
Sul 40:1 (OH)	0.57	0.58	9.1E-06	5.1E-08	4.8	5.6
Sul 41:1 (OH)	0.50	0.52	3.6E-07	6.4E-09	5.7	6.1
Sul 40:0 (2OH)	0.71	0.88	1.7E-05	3.4E-02	4.3	1.8
Sul 42:1 (OH)	0.58	0.61	8.5E-06	1.2E-07	4.9	5.5
Sul 42:1 (2OH)	0.55	0.60	8.8E-04	1.1E-04	3.3	3.8
Sul 42:0 (2OH)	0.72	0.85	8.2E-05	2.2E-02	3.9	2.0
SulfoHex ₂ Cer 42:2	1.34	1.84	9.1E-02	2.7E-02	-1.4	-2.0
PI 36:4	0.59	0.82	2.7E-05	4.9E-02	4.3	1.7
PI 36:3	0.54	0.75	8.6E-06	1.3E-02	4.6	2.3
PI 36:2	0.62	0.81	6.5E-06	1.2E-02	4.7	2.3
PI 36:1	0.53	0.70	4.7E-07	5.0E-04	5.4	3.4
PI 38:5	0.52	0.74	7.1E-07	1.1E-02	5.3	2.3
PI 38:3	0.60	0.72	6.6E-06	7.3E-04	4.8	3.3

Table 26. Statistical parameters for MALDI-MS analysis of non-cancerous plasma samples and cancerous plasma samples of males (M) and females (F) for prostate cancer.

Species	Fold change	P-value	T-value
cholesterol sulfate	0.61	7.6E-09	6.1
SM 32:1	0.60	8.9E-12	7.4
SM 33:1	0.59	2.7E-11	7.2
SM 34:2	0.60	1.6E-10	6.8
SM 34:1	0.65	2.9E-10	6.7
SM 36:2	0.61	1.2E-08	6.0
SM 36:1	0.66	1.8E-08	5.9
SM 37:1	0.59	3.6E-10	6.7
SM 38:2	0.58	1.9E-10	6.8
SM 38:1	0.62	2.9E-11	7.2
SM 39:1	0.54	2.5E-13	8.0
SM 40:3	0.46	6.2E-09	6.1
SM 40:2	0.58	5.4E-12	7.5
SM 40:1	0.59	6.8E-13	7.9
SM 41:2	0.57	1.5E-12	7.7
SM 41:1	0.58	2.1E-13	8.1
SM 42:2	0.64	2.9E-09	6.3
SM 42:1	0.59	1.6E-12	7.7
SM 43:2	0.56	1.5E-08	5.9

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SM 43:1	0.46	4.0E-08	5.7
Sul 34:1	0.62	4.0E-10	6.7
Sul 34:2 (OH)	0.52	1.9E-08	5.9
Sul 34:1 (OH)	0.61	2.4E-09	6.3
Sul 34:0 (OH)	0.45	3.7E-10	6.7
Sul 40:2	0.47	1.5E-06	5.0
Sul 40:1	0.47	4.0E-12	7.5
Sul 40:2 (OH)	0.49	9.0E-07	5.0
Sul 41:1	0.51	2.6E-08	5.8
Sul 40:1 (OH)	0.56	2.6E-11	7.2
Sul 42:2	0.57	1.8E-08	5.9
Sul 42:1	0.51	2.1E-09	6.3
Sul 41:1 (OH)	0.53	6.7E-11	7.0
Sul 42:2 (OH)	0.64	3.8E-08	5.7
Sul 42:1 (OH)	0.59	3.5E-11	7.1
Sul 42:1 (2OH)	0.55	1.0E-06	5.0
PI 36:4	0.59	1.5E-06	4.9
PI 36:3	0.57	3.0E-06	4.7
PI 38:5	0.53	1.1E-07	5.5
PI 38:4	0.60	1.8E-09	6.3
PI 38:3	0.61	7.8E-09	6.0

Table 27. Statistical parameters for the MALDI-MS analysis of non-cancerous urine samples and cancerous urine samples of males (M) and females (F) for kidney and prostate cancer.

Species	Kidney						Prostate		
	Fold change		P-value		T-value		Fold change	P-value	T-value
	F	M	F	M	F	M	M	M	M
cortisol sulfate	1.9	3.8	5.2E-02	1.3E-03	-1.7	-3.1	1.5	5.2E-02	-1.7
lithocholic acid sulfate	1.4	2.4	2.0E-01	4.4E-02	-0.9	-1.7	1.1	3.8E-01	-0.3
cholesterol sulfate	1.1	1.7	3.8E-01	1.3E-02	-0.3	-2.3	1.5	1.0E-01	-1.3
taurolithocholic acid	0.6	1.6	1.0E-01	9.7E-02	1.3	-1.3	1.1	3.9E-01	-0.3
sulfocholic acid	2.3	6.6	5.7E-02	5.7E-03	-1.7	-2.6	1.9	1.7E-02	-2.2
taurodeoxycholic acid	0.8	2.8	3.3E-01	8.6E-03	0.5	-2.4	1.5	8.9E-02	-1.4
sulfoglycolithocholic acid	1.0	1.6	4.4E-01	2.9E-02	0.2	-1.9	1.2	2.4E-01	-0.7
taurocholic acid	0.6	2.0	8.6E-02	1.3E-02	1.4	-2.3	1.6	8.6E-02	-1.4
glycochenodeoxycholic acid sulfate	1.0	2.3	4.8E-01	1.5E-02	0.0	-2.2	1.2	2.6E-01	-0.7
psychosine sulfate	1.1	1.4	3.8E-01	5.2E-02	-0.3	-1.7	1.1	2.8E-01	-0.6
Sul 34:1 (OH)	1.1	1.0	3.8E-01	4.4E-01	-0.3	-0.1	1.0	4.3E-01	0.2
Sul 36:1 (OH)	1.7	1.8	7.8E-02	3.9E-03	-1.5	-2.8	1.3	1.2E-01	-1.2
Sul 38:1	1.2	1.0	3.2E-01	4.9E-01	-0.5	0.0	0.8	3.0E-01	0.5
Sul 38:1 (OH)	1.1	0.7	4.3E-01	1.3E-01	-0.2	1.1	0.8	1.9E-01	0.9
Sul 40:2	1.6	1.5	1.8E-01	8.2E-02	-1.0	-1.4	0.8	2.1E-01	0.8
Sul 41:2	1.8	1.9	7.9E-02	1.8E-03	-1.5	-3.0	1.4	9.3E-02	-1.3
Sul 41:1	0.9	1.0	4.1E-01	4.5E-01	0.2	0.1	0.9	3.2E-01	0.5
Sul 40:1 (OH)	0.8	0.9	3.0E-01	3.4E-01	0.5	0.4	0.9	2.6E-01	0.7

Sul 40:0 (OH)	0.7	1.0	1.6E-01	4.5E-01	1.0	0.1	0.9	2.9E-01	0.6
Sul 42:3	2.9	3.6	3.8E-02	3.3E-04	-1.9	-3.6	1.6	2.4E-02	-2.0
Sul 42:2	2.2	2.1	5.7E-02	5.1E-03	-1.7	-2.6	1.0	4.4E-01	-0.1
Sul 42:1	1.2	1.4	2.8E-01	8.3E-02	-0.6	-1.4	1.0	4.4E-01	-0.1
Sul 41:1 (OH)	0.9	0.9	3.6E-01	3.6E-01	0.4	0.4	0.9	2.8E-01	0.6
Sul 41:0 (OH)	0.8	0.9	2.3E-01	3.3E-01	0.8	0.5	0.8	2.4E-01	0.7
Sul 40:0 (2OH)	0.7	0.9	1.7E-01	3.3E-01	1.0	0.5	0.8	2.1E-01	0.8
Sul 42:3 (OH)	1.6	2.0	8.5E-02	6.7E-04	-1.4	-3.3	1.5	5.6E-02	-1.6
Sul 41:0 (2OH)	0.8	0.9	2.0E-01	3.9E-01	0.9	0.3	0.9	2.6E-01	0.6
Sul 43:2 (OH)	1.5	1.9	1.2E-01	1.0E-03	-1.2	-3.2	1.4	7.1E-02	-1.5
Sul 42:1 (2OH)	0.8	1.1	2.0E-01	2.8E-01	0.9	-0.6	0.9	3.2E-01	0.5
Sul 42:0 (2OH)	0.8	1.0	2.8E-01	4.5E-01	0.6	-0.1	0.9	3.7E-01	0.3
Sul 43:1 (2OH)	1.7	2.1	7.7E-02	3.7E-04	-1.5	-3.5	1.6	3.3E-02	-1.9
Sul 43:0 (2OH)	1.4	1.3	1.8E-01	8.7E-02	-0.9	-1.4	1.0	5.0E-01	0.0
SulfoHex ₂ Cer 34:1	2.9	2.8	1.9E-02	2.6E-03	-2.2	-2.9	1.4	1.1E-01	-1.3
SulfoHex ₂ Cer 34:1 (OH)	2.1	1.8	5.4E-02	6.3E-03	-1.7	-2.6	1.6	7.2E-02	-1.5
SulfoHex ₂ Cer 36:1	2.2	3.4	4.1E-02	1.8E-04	-1.8	-3.7	1.7	1.7E-02	-2.2
SulfoHex ₂ Cer 38:1	3.1	3.4	4.2E-02	2.1E-03	-1.8	-3.0	1.6	5.4E-02	-1.6
SulfoHex ₂ Cer 38:1 (OH)	1.9	1.9	4.9E-02	5.5E-03	-1.7	-2.6	1.5	8.7E-02	-1.4
SulfoHex ₂ Cer 40:2	3.0	3.8	3.7E-02	1.2E-03	-1.9	-3.2	1.6	3.2E-02	-1.9
SulfoHex ₂ Cer 40:1	3.7	2.5	3.5E-02	2.4E-03	-1.9	-2.9	1.3	1.7E-01	-1.0
SulfoHex ₂ Cer 41:1	2.3	2.7	4.3E-02	6.3E-05	-1.8	-4.0	1.6	2.8E-02	-2.0
SulfoHex ₂ Cer 40:1 (OH)	1.7	0.8	1.8E-01	2.0E-01	-1.0	0.9	0.7	1.3E-01	1.2
SulfoHex ₂ Cer 42:3	2.6	3.5	3.9E-02	1.3E-03	-1.9	-3.1	1.6	2.7E-02	-2.0
SulfoHex ₂ Cer 42:2	4.5	3.3	2.5E-02	1.1E-03	-2.1	-3.2	1.2	2.4E-01	-0.7
SulfoHex ₂ Cer 42:1	3.3	2.6	3.5E-02	1.1E-03	-1.9	-3.2	1.3	1.6E-01	-1.0
SulfoHex ₂ Cer 41:1 (OH)	1.8	1.7	7.9E-02	1.0E-02	-1.5	-2.4	1.3	1.6E-01	-1.0
SulfoHex ₂ Cer 40:0 (2OH)	1.2	0.8	3.1E-01	2.2E-01	-0.5	0.8	0.7	7.4E-02	1.5

Example C: UHPSFC/MS lipidomic analysis of human plasma of cancer patients for the differentiation of various cancerous samples

- 5 The aim of the invention is not only to differentiate non-cancerous and cancerous samples from body fluids, but also the prediction of the localization of the cancer in the body. It was found that there is a difference of the lipid profile depending on the cancer type, which can be determined in the biological fluid. OPLS-DA could be again a tool to visualize the most probably minor differences of the lipid profile.
- 10 Figure 19 represents the OPLS-DA plot of various cancer type samples (breast, kidney, prostate) from males. This figure confirms that there is a difference in the lipid profile of different cancer types. Figure 20 shows the OPLS-DA plot for the differentiation of prostate and kidney cancer samples from males. The sensitivity is 76.1% and the specificity is 80.3% for males.

Figure 21 represents the OPLS-DA plot for the differentiation of breast and kidney cancer samples from females. The sensitivity is 74.2% and the specificity is 96.8% for females.

Example D – Experimental results relating to diagnostics of pancreatic cancer:

All quantified lipids in human serum of males (M) and females (F) for pancreatic cancer patients and healthy volunteers are summarized in Table 28 for shotgun measurements, in Table 29 for UHPSFC/MS measurements and in Table 30 for MALDI-MS measurements, together with fold changes, p-values, and T-values.

Pancreatic cancer model based on known classification using shotgun and UHPSFC/MS data:

These statistical models are built based on 292 known serum samples both for shotgun and UHPSFC/MS data sets. Absolute concentrations (normalization to internal standard) are used for these statistical analyses. First, the non-supervised PCA method is used to check the regular distribution of data, and it already shows partial separation of classes of cancer patients and healthy volunteers (controls). Then, supervised OPLS-DA model is prepared to improve class separation of non-cancerous and cancerous serum samples (Figure 22). For this example of combination of data obtained using UHPSFC/MS and shotgun MS, specificity 98.7% and sensitivity 98.6 % (accuracy 98.6%) is obtained. These models include all lipids used (complete lipidome) and are automatically computed by SIMCA software. Figures 23 (males) and Figure 24 (females) show subsequently the OPLS-DA statistical models after gender separation. These models again illustrate another improvement of non-cancerous and cancerous samples differentiation, where sensitivity 100%, specificity 100% (accuracy 100%) is obtained in case of males and sensitivity 100%, specificity 95.9% (accuracy 98.7%) is obtained for females. It is worth noting that there is the gap between both groups, which visually highlights the reliability of the model for pancreatic cancer classification.

Pancreatic cancer model based on unknown classification using shotgun and UHPSFC/MS data:

The next step is the verification of the quality of OPLS-DA model prepared for samples with known classification for blinded samples with unknown classification. The probability of being the cancer patient is estimated using 4 final models: #1/ OPLS-DA of shotgun MS, #2/ OPLS-DA of UHPSFC/MS, #3/ OPLS-DA of all data, #4 Support vector machines (SVM) of all data, and finally the average of all models, which is used for the final assignment. The observation is classified as tumor if this estimate is bigger than 0.5 and as healthy volunteer if this probability is smaller than 0.5 (Figures 25 and 26). Triangle symbols shows observations “sure healthy”, square symbols as “healthy”, star symbols as “cancer” and diamond symbols as “sure cancer”. The models resulted in very good prediction ability as was expected (4 wrongly classified from 73 unknown samples). Tables 31 and 32 show the resulting assignments of samples.

Table 28. List of all quantified lipids with shotgun measurement together with fold changes, p-values, and T-values.

Lipid	Fold change		p-value		T-value	
	M	F	M	F	M	F
CE 14:0	0.88	0.73	9.7E-02	1.7E-04	1.3	3.8
CE 16:0	1.02	0.96	3.5E-01	2.4E-01	-0.4	0.7
CE 16:1	1.35	0.83	2.7E-03	1.8E-02	-2.8	2.1
CE 18:1	1.15	0.94	1.2E-02	1.9E-01	-2.3	0.9
CE 18:2	0.90	0.80	2.9E-02	5.2E-04	2.0	3.4
CE 18:3	0.87	0.70	4.6E-02	1.3E-04	1.7	3.9
CE 20:4	0.94	1.00	1.9E-01	4.8E-01	0.9	0.1
CE 20:5	0.65	0.77	1.0E-02	1.1E-02	2.5	2.4
CE 22:4	1.09	0.90	7.5E-02	1.3E-01	-1.5	1.1
CE 22:5	2.68	0.83	1.5E-05	2.1E-01	-4.4	0.8
CE 22:6	0.95	1.01	2.4E-01	4.6E-01	0.7	-0.1
Cer d18:0/16:1;Cer d18:0/15:2(1OH)	0.92	1.00	5.6E-02	5.0E-01	1.6	0.0
Cer d18:0/16:2	0.96	0.96	2.1E-01	2.1E-01	0.8	0.8
Cer d18:0/18:2	0.96	0.97	2.6E-01	2.3E-01	0.6	0.8
Cer d18:0/24:0;Cer d18:0/23:1(1OH)	0.94	0.75	2.9E-01	3.1E-03	0.6	2.8
Cer d18:0/24:1;Cer d18:0/23:2(1OH)	1.13	1.00	1.8E-02	4.6E-01	-2.2	-0.1
Cer d18:1/16:0;Cer d18:1/15:1(1OH)	1.64	1.29	1.8E-12	2.6E-03	-8.1	-2.9
Cer d18:1/16:1;Cer d18:1/15:2(1OH)	1.00	0.92	4.8E-01	4.9E-02	-0.1	1.7
Cer d18:1/16:2	1.08	0.89	9.4E-02	1.4E-02	-1.4	2.3
Cer d18:1/18:0;Cer d18:1/17:1(1OH)	1.71	1.54	4.3E-13	6.2E-06	-8.1	-4.5
Cer d18:1/18:2	1.07	0.89	1.2E-01	1.1E-02	-1.2	2.4
Cer d18:1/18:3	1.21	0.79	1.0E-03	1.7E-04	-3.2	3.8
Cer d18:1/20:0;Cer d18:1/19:1(1OH)	1.23	1.28	5.9E-02	2.1E-02	-1.6	-2.1
Cer d18:1/22:0;Cer d18:1/21:1(1OH)	1.10	1.09	6.8E-02	1.0E-01	-1.5	-1.3
Cer d18:1/23:0;Cer d18:1/22:1(1OH)	0.85	0.77	1.5E-02	3.0E-04	2.3	3.6
Cer d18:1/24:0;Cer d18:1/23:1(1OH)	0.87	0.78	1.8E-02	4.9E-04	2.2	3.4
Cer d18:1/24:1;Cer d18:1/23:2(1OH)	1.53	1.36	6.2E-13	4.8E-05	-8.3	-4.1
Cer d18:1/25:0;Cer d18:1/24:1(1OH)	0.95	0.73	1.9E-01	2.5E-05	0.9	4.3
DG 30:0	1.05	1.10	3.6E-01	1.7E-01	-0.4	-1.0
DG 31:0	1.11	0.95	7.3E-02	2.5E-01	-1.5	0.7
DG 32:0	1.14	1.35	1.4E-01	3.4E-03	-1.1	-2.8
DG 32:1	1.10	1.12	2.5E-01	1.2E-01	-0.7	-1.2
DG 32:2	0.98	1.04	4.2E-01	3.1E-01	0.2	-0.5
DG 34:0	0.59	1.06	1.1E-03	2.1E-01	3.4	-0.8
DG 34:1	1.11	1.27	2.1E-01	1.1E-02	-0.8	-2.3
DG 34:2	1.05	1.13	3.4E-01	9.1E-02	-0.4	-1.4
DG 34:3	0.91	0.98	2.1E-01	4.3E-01	0.8	0.2
DG 36:0	0.35	0.88	2.7E-03	1.0E-01	3.1	1.3
DG 36:1	1.01	1.33	4.6E-01	2.1E-03	-0.1	-2.9
DG 36:2	1.09	1.35	2.6E-01	1.1E-03	-0.7	-3.2

DG 36:3	0.89	1.23	1.6E-01	1.7E-02	1.0	-2.2
DG 36:4	0.78	1.10	1.8E-02	1.8E-01	2.2	-0.9
DG 38:2	1.07	1.03	2.2E-01	3.3E-01	-0.8	-0.4
DG 38:3	1.09	0.90	1.9E-01	9.9E-02	-0.9	1.3
DG 38:4	1.03	1.06	3.8E-01	2.3E-01	-0.3	-0.7
DG 38:5	0.92	1.24	2.2E-01	2.2E-03	0.8	-2.9
DG 38:6	0.77	1.19	1.8E-02	8.9E-02	2.2	-1.4
Hex2Cer d18:1/16:0;Hex2Cer d18:1/15:1(1OH)	1.25	1.08	8.2E-05	1.5E-01	-3.9	-1.1
Hex2Cer d18:1/20:0;Hex2Cer d18:1/19:1(1OH)	1.32	0.83	8.0E-02	1.3E-01	-1.4	1.2
Hex2Cer d18:1/21:0(1OH)	1.12	0.95	1.8E-02	2.3E-01	-2.1	0.8
Hex2Cer d18:1/22:0;Hex2Cer d18:1/21:1(1OH)	0.95	0.80	2.1E-01	1.0E-03	0.8	3.2
Hex2Cer d18:1/24:1;Hex2Cer d18:1/23:2(1OH)	1.34	1.19	6.6E-05	2.2E-02	-4.1	-2.1
HexCer d18:1/16:0;HexCer d18:1/15:1(1OH)	1.50	1.12	1.9E-13	7.8E-02	-8.3	-1.4
HexCer d18:1/20:0;HexCer d18:1/19:1(1OH)	1.19	1.10	3.3E-02	2.1E-01	-1.9	-0.8
HexCer d18:1/22:0;HexCer d18:1/21:1(1OH)	1.02	0.87	3.4E-01	1.7E-02	-0.4	2.2
HexCer d18:1/24:0;HexCer d18:1/23:1(1OH)	0.96	0.79	2.6E-01	7.7E-04	0.7	3.3
HexCer d18:1/24:1;HexCer d18:1/23:2(1OH)	1.56	1.14	8.7E-13	5.1E-02	-7.9	-1.7
HexCer d18:1/25:0;HexCer d18:1/24:1(1OH)	0.91	1.10	2.2E-02	1.1E-02	2.1	-2.3
Chol	1.12	0.95	8.3E-03	2.8E-01	-2.5	0.6
LPC 16:0	0.86	0.82	3.1E-03	1.1E-03	2.9	3.2
LPC 16:1	0.97	0.75	3.5E-01	2.1E-04	0.4	3.7
LPC 18:0	0.77	0.80	1.5E-04	1.9E-03	3.9	3.0
LPC 18:1	0.92	0.85	8.7E-02	8.3E-03	1.4	2.5
LPC 18:2	0.62	0.68	3.4E-07	3.0E-07	5.8	5.4
LPC 20:1	1.13	0.74	1.7E-01	6.1E-04	-1.0	3.4
LPC 20:3	0.80	0.76	8.4E-04	5.8E-05	3.3	4.1
LPC 20:4	0.75	0.87	2.0E-05	2.3E-02	4.5	2.0
LPC 22:6	0.72	1.00	1.7E-06	4.8E-01	5.2	0.1
LPE 16:0	1.12	0.94	1.2E-01	2.1E-01	-1.2	0.8
LPE 18:0	1.02	0.89	4.3E-01	6.9E-02	-0.2	1.5
LPE 18:1	0.92	0.84	2.5E-01	3.5E-02	0.7	1.8
LPE 18:2	0.79	0.83	4.7E-02	2.2E-02	1.7	2.1
LPE 20:4	0.78	1.25	2.1E-02	3.7E-02	2.1	-1.8
LPE 22:6	0.98	1.16	4.4E-01	6.2E-02	0.2	-1.6
LPG 20:0	0.87	0.89	2.8E-01	3.0E-01	0.6	0.5
LPG O-18:0;LPG 17:0	0.85	1.16	2.0E-01	1.7E-01	0.8	-1.0
LPG O-20:0;LPG 19:0	0.93	1.21	3.3E-01	9.6E-02	0.4	-1.3
LPG O-22:0;LPG 21:0	0.91	1.32	2.4E-01	1.6E-02	0.7	-2.2
MG 16:0	0.89	1.13	4.3E-02	4.6E-02	1.8	-1.7
MG 17:0	0.67	1.54	5.6E-02	1.2E-02	1.7	-2.3
MG 18:0	0.67	1.07	2.3E-03	1.3E-01	3.1	-1.1
MG 18:1	1.35	1.72	3.3E-02	8.8E-03	-1.9	-2.4
MG 22:0	1.19	1.04	1.3E-01	4.0E-01	-1.1	-0.3
PA 38:4;PA P-40:10;PA P-29:3	0.79	2.08	5.4E-03	7.7E-07	2.7	-5.1
PC 30:0	1.21	0.92	6.8E-03	1.2E-01	-2.6	1.2
PC 32:0;PC O-33:0	1.55	1.10	2.5E-13	1.1E-01	-8.1	-1.2
PC 32:1;PC P-33:0	1.90	0.93	6.1E-06	2.7E-01	-4.6	0.6

PC 32:2;PC P-33:1	0.67	0.53	1.4E-03	1.6E-06	3.1	5.0
PC 34:1;PC P-35:0	1.46	1.02	1.2E-09	4.0E-01	-6.5	-0.3
PC 34:2;PC P-35:1	1.10	0.86	2.4E-02	1.1E-02	-2.0	2.4
PC 34:3;PC P-35:2	1.06	0.76	1.9E-01	1.2E-04	-0.9	3.9
PC 34:4;PC P-35:3	0.79	0.70	2.7E-03	2.0E-05	2.9	4.4
PC 36:0;PC P-38:6	0.43	0.50	3.2E-03	4.7E-04	2.9	3.5
PC 36:1;PC P-37:0	1.30	0.95	2.4E-04	2.6E-01	-3.6	0.7
PC 36:2;PC P-37:1	1.02	0.86	3.3E-01	1.8E-02	-0.4	2.2
PC 36:3;PC P-37:2	1.16	0.85	3.1E-03	9.4E-03	-2.8	2.4
PC 36:4;PC P-37:3	1.04	0.95	2.4E-01	2.5E-01	-0.7	0.7
PC 36:5;PC P-37:4	0.72	0.81	2.5E-02	1.4E-02	2.1	2.3
PC 38:2;PC P-40:8;PC P-39:1	1.10	0.47	3.7E-01	7.9E-04	-0.3	3.3
PC 38:3;PC P-40:9;PC P-39:2	1.12	0.94	2.2E-02	2.1E-01	-2.1	0.8
PC 38:4;PC P-40:10;PC P-29:3	1.00	1.01	4.8E-01	4.6E-01	0.0	-0.1
PC 38:5;PC P-39:4	0.93	0.92	1.8E-01	1.2E-01	0.9	1.2
PC 38:6;PC P-39:5	0.94	1.02	1.9E-01	3.8E-01	0.9	-0.3
PC 40:4;PC P-42:10;PC P-41:3	1.17	0.89	7.4E-03	6.6E-02	-2.5	1.5
PC 40:5;PC P-41:4	1.06	1.03	2.4E-01	3.5E-01	-0.7	-0.4
PC 40:6;PC P-41:5	0.98	1.17	4.1E-01	2.9E-02	0.2	-1.9
PC O-32:0;PC 31:0	1.36	0.91	3.6E-07	1.2E-01	-5.4	1.2
PC O-34:0;PC 33:0	1.16	0.92	3.8E-02	1.4E-01	-1.8	1.1
PC P-32:0;PC 31:1	1.43	0.82	6.2E-11	2.3E-03	-7.1	3.0
PC P-34:0;PC 33:1	1.44	0.96	1.6E-11	3.0E-01	-7.5	0.5
PC P-34:1;PC 33:2	1.04	0.71	2.7E-01	2.7E-06	-0.6	4.9
PC P-36:0;PC 35:1	1.05	0.71	3.0E-01	2.2E-04	-0.5	3.7
PC P-36:1;PC 35:2	1.04	0.79	2.8E-01	6.4E-04	-0.6	3.4
PC P-36:2;PC 35:3	1.07	0.74	1.3E-01	3.8E-05	-1.1	4.2
PC P-36:3;PC 35:4	1.06	0.83	1.4E-01	6.8E-03	-1.1	2.5
PC P-36:4;PC 35:5	0.99	0.84	4.5E-01	7.9E-03	0.1	2.5
PC P-38:2;PC 37:3	0.91	0.69	1.8E-01	5.6E-05	0.9	4.1
PC P-38:3;PC 37:4	1.08	0.87	5.8E-02	2.4E-02	-1.6	2.0
PC P-38:4;PC 37:5	1.13	0.96	4.1E-03	2.7E-01	-2.7	0.6
PC P-38:5;PC 37:6	0.96	0.88	2.3E-01	3.7E-02	0.8	1.8
PC P-40:3;PC 39:4	0.96	0.72	2.8E-01	7.2E-05	0.6	4.0
PC P-40:4;PC 39:5	1.01	0.81	4.6E-01	6.5E-03	-0.1	2.6
PC P-40:5;PC 39:6	1.00	0.97	4.8E-01	3.1E-01	0.0	0.5
PE 32:0;PE O-33:0	1.47	1.27	2.0E-03	4.4E-02	-3.0	-1.7
PE 32:1;PE P-33:0	2.48	1.19	1.4E-06	6.8E-02	-4.9	-1.5
PE 34:0;PE P-36:6	1.07	0.76	2.8E-01	3.2E-03	-0.6	2.8
PE 34:1;PE P-35:0	1.98	1.20	1.5E-09	4.4E-02	-6.4	-1.7
PE 34:2;PE P-35:1	1.78	1.11	1.2E-07	1.4E-01	-5.5	-1.1
PE 34:3;PE P-35:2	1.55	0.96	1.9E-05	3.1E-01	-4.3	0.5
PE 36:0;PE P-38:6	0.77	0.84	1.5E-03	1.7E-02	3.2	2.2
PE 36:1;PE P-37:0	1.18	1.06	8.1E-02	2.8E-01	-1.4	-0.6
PE 36:2;PE P-37:1	1.33	1.04	4.8E-03	3.4E-01	-2.7	-0.4
PE 36:3;PE P-37:2	1.43	0.97	3.1E-03	3.7E-01	-2.8	0.3
PE 36:4;PE P-37:3	1.70	1.15	2.1E-08	5.7E-02	-5.9	-1.6

PE 36:5;PE P-37:4	1.26	0.93	1.8E-02	1.9E-01	-2.2	0.9
PE 38:0;PE P-40:6;PE O-39:0	0.77	0.81	1.8E-04	6.2E-03	3.8	2.6
PE 38:1;PE P-40:7;PE P-39:0	0.94	0.83	1.5E-01	5.0E-03	1.1	2.7
PE 38:2;PE P-40:8;PE P-39:1	1.05	1.51	2.4E-01	6.9E-04	-0.7	-3.3
PE 38:3;PE P-40:9;PE P-39:2	1.67	0.90	4.6E-05	1.6E-01	-4.1	1.0
PE 38:4;PE P-40:10;PE P-29:3	1.41	1.14	3.8E-05	6.0E-02	-4.2	-1.6
PE 38:5;PE P-39:4	1.49	1.02	2.3E-05	3.9E-01	-4.3	-0.3
PE 38:6;PE P-39:5	1.65	1.19	1.3E-07	4.4E-02	-5.6	-1.7
PE 38:7;PE O-38:0;PE 37:0	1.36	0.96	9.7E-06	3.0E-01	-4.5	0.5
PE 40:1;PE P-42:7;PE P-41:0	0.88	1.05	2.2E-01	3.7E-01	0.8	-0.3
PE 40:2;PE P-42:8;PE P-41:1	0.92	0.94	2.6E-01	3.4E-01	0.6	0.4
PE 40:3;PE P-42:9;PE P-41:2	0.85	0.89	6.9E-02	1.7E-01	1.5	1.0
PE 40:4;PE P-42:10;PE P-41:3	1.50	1.03	9.7E-05	3.3E-01	-3.9	-0.4
PE 40:5;PE P-41:4	1.54	1.13	3.9E-05	9.2E-02	-4.1	-1.3
PE 40:6;PE P-41:5	1.42	1.30	2.8E-04	3.3E-03	-3.6	-2.8
PE 40:7;PE O-40:0;PE 39:0	1.51	1.03	1.9E-06	3.6E-01	-4.9	-0.4
PE 40:8;PE P-40:0;PE 39:1	1.19	0.96	3.9E-03	3.0E-01	-2.7	0.5
PE 42:9;PE P-42:1;PE 41:2	0.97	1.09	4.1E-01	3.0E-01	0.2	-0.5
PE P-34:0;PE 33:1	1.03	0.66	3.5E-01	9.1E-08	-0.4	5.8
PE P-34:1;PE 33:2	0.86	0.67	6.1E-02	6.0E-06	1.6	4.7
PE P-36:0;PE 35:1	1.31	0.89	4.1E-02	2.2E-01	-1.8	0.8
PE P-36:1;PE 35:2	1.12	0.80	6.7E-02	9.5E-04	-1.5	3.2
PE P-36:2;PE 35:3	0.89	0.69	8.8E-02	7.9E-06	1.4	4.6
PE P-36:3;PE 35:4	0.72	0.56	8.8E-04	2.6E-06	3.3	5.0
PE P-36:4;PE 35:5	0.76	0.79	5.3E-04	4.0E-03	3.5	2.7
PE P-38:2;PE 37:3	1.39	0.57	4.9E-02	5.1E-06	-1.7	4.8
PE P-38:3;PE 37:4	0.87	0.69	4.8E-02	8.8E-05	1.7	4.0
PE P-38:4;PE 37:5	0.74	0.68	1.9E-04	1.7E-05	3.8	4.4
PE P-38:5;PE 37:6	0.73	0.71	3.6E-05	5.7E-05	4.3	4.1
PE P-40:4;PE 39:5	0.91	0.80	9.6E-02	8.9E-04	1.3	3.3
PE P-40:5;PE 39:6	0.83	0.78	8.9E-03	8.0E-04	2.5	3.3
PG 32:0;PG O-33:0	0.84	1.35	2.6E-01	6.7E-02	0.7	-1.5
PG 32:1;PG P-33:0	0.90	1.32	3.6E-01	6.9E-02	0.4	-1.5
PG 34:0;PG P-36:6	0.61	0.96	5.7E-02	4.2E-01	1.6	0.2
PG 34:1;PG P-35:0	0.86	1.24	2.5E-01	6.5E-02	0.7	-1.5
PG 34:2;PG P-35:1	0.76	1.09	1.1E-01	2.8E-01	1.3	-0.6
PG 36:1;PG P-37:0	0.86	1.13	1.7E-01	1.5E-01	1.0	-1.0
PG 36:2;PG P-37:1	0.83	1.14	1.8E-01	1.4E-01	1.0	-1.1
PG 36:3;PG P-37:2	0.64	0.67	1.7E-01	2.6E-02	1.0	2.0
PG 36:4;PG P-37:3	0.70	1.19	5.1E-02	1.8E-01	1.7	-0.9
PI 32:0;PI O-33:0	0.90	1.27	3.1E-01	1.2E-01	0.5	-1.2
PI 32:1;PI P-33:0	1.63	0.92	3.4E-03	2.7E-01	-2.8	0.6
PI 34:0;PI P-36:6	0.92	0.81	4.0E-01	1.5E-01	0.3	1.0
PI 34:1;PI P-35:0	1.58	0.86	9.7E-06	6.3E-02	-4.5	1.6
PI 34:2;PI P-35:1	1.53	0.98	2.3E-06	4.1E-01	-4.8	0.2
PI 36:0;PI P-38:6	1.21	0.82	1.8E-01	1.7E-01	-0.9	0.9
PI 36:1;PI P-37:0	1.34	0.75	4.4E-03	2.8E-03	-2.7	2.9

PI 36:2;PI P-37:1	1.38	0.92	2.7E-04	1.7E-01	-3.6	1.0
PI 36:3;PI P-37:2	1.53	0.95	1.2E-05	2.9E-01	-4.5	0.6
PI 36:4;PI P-37:3	1.34	0.95	7.3E-04	3.1E-01	-3.3	0.5
PI 38:2;PI P-40:8;PI P-39:1	1.43	0.90	2.0E-04	1.4E-01	-3.7	1.1
PI 38:3;PI P-40:9;PI P-39:2	1.26	0.80	2.7E-02	2.8E-02	-2.0	1.9
PI 38:4;PI P-40:10;PI P-29:3	1.21	0.98	2.3E-02	4.0E-01	-2.1	0.3
PI 38:5;PI P-39:4	1.34	0.92	1.0E-03	2.0E-01	-3.2	0.8
PI 38:6;PI P-39:5	1.54	1.02	4.2E-04	4.4E-01	-3.5	-0.2
PI 40:0;PI P-42:6;PI O-41:0	1.16	0.95	1.3E-01	2.9E-01	-1.1	0.6
PI 40:4;PI P-42:10;PI P-41:3	1.52	0.98	2.2E-04	4.4E-01	-3.7	0.2
PI 40:5;PI P-41:4	1.44	1.05	1.2E-04	2.9E-01	-3.9	-0.6
PI 40:6;PI P-41:5	1.71	1.09	1.8E-06	2.1E-01	-4.9	-0.8
PI 42:3;PI P-43:2	1.32	0.93	1.6E-02	2.8E-01	-2.2	0.6
PI P-36:0;PI 35:1	1.30	0.89	1.0E-01	2.9E-01	-1.3	0.6
PI P-36:1;PI 35:2	1.07	1.01	3.4E-01	4.8E-01	-0.4	-0.1
PI P-38:3;PI 37:4	1.22	0.92	4.3E-02	2.7E-01	-1.8	0.6
PS 34:0;PS P-36:6	1.36	1.12	5.4E-03	2.2E-01	-2.6	-0.8
PS 34:2;PS P-35:1	1.03	1.13	3.4E-01	1.1E-01	-0.4	-1.2
PS 36:1;PS P-37:0	1.46	1.07	1.1E-02	3.3E-01	-2.4	-0.5
PS 38:4;PS P-40:10;PS P-29:3	1.29	1.48	7.9E-03	2.1E-04	-2.5	-3.6
PS 38:6;PS P-39:5	0.88	1.40	7.0E-02	3.9E-03	1.5	-2.7
PS 42:1;PS P-43:0	0.82	1.34	8.1E-02	2.0E-02	1.4	-2.1
PS P-32:0;PS 31:1	1.23	0.98	7.5E-04	4.3E-01	-3.3	0.2
SM 32:1	0.93	0.84	1.1E-01	7.9E-03	1.2	2.5
SM 33:1	1.03	0.94	3.0E-01	2.2E-01	-0.5	0.8
SM 34:0	1.38	1.09	2.6E-06	1.1E-01	-4.8	-1.2
SM 34:1	1.28	1.06	2.7E-09	1.6E-01	-6.5	-1.0
SM34:2	1.07	0.97	6.2E-02	3.1E-01	-1.6	0.5
SM 35:1	0.77	1.65	1.3E-03	1.2E-03	3.1	-3.2
SM 36:0	2.02	1.94	5.5E-03	3.0E-03	-2.6	-2.8
SM 36:1	1.16	1.28	1.7E-02	1.3E-03	-2.2	-3.1
SM 36:2	1.10	1.11	3.0E-02	6.5E-02	-1.9	-1.5
SM 37:0	0.83	0.76	2.6E-01	1.5E-01	0.7	1.1
SM 39:1	0.71	0.65	1.9E-05	2.4E-05	4.6	4.4
SM 40:0	0.96	0.84	2.8E-01	1.4E-02	0.6	2.3
SM 40:1	0.90	0.84	6.0E-02	2.1E-02	1.6	2.1
SM 41:1	0.78	0.70	6.5E-05	5.6E-06	4.2	4.7
SM 41:2	0.91	0.80	4.8E-02	1.5E-03	1.7	3.1
SM 42:2	1.31	1.10	1.1E-09	9.3E-02	-6.6	-1.3
SM 43:1	1.45	0.60	3.8E-02	1.6E-05	-1.8	4.4
SM 44:2	1.65	0.93	6.2E-03	2.6E-01	-2.6	0.6
SulfoHexCer 41:0;SulfoHexCer 40:1(1OH)	1.06	1.14	2.1E-01	7.7E-02	-0.8	-1.5
SulfoHexCer 41:1;SulfoHexCer 40:2(1OH)	0.92	0.83	1.4E-01	3.3E-02	1.1	1.9
SulfoHexCer 43:0;SulfoHexCer 42:1(1OH)	1.20	0.86	2.7E-02	6.5E-02	-2.0	1.5
SulfoHexCer 43:1;SulfoHexCer 42:2(1OH)	0.72	1.07	2.7E-04	2.9E-01	3.7	-0.5
SulfoHexCer 43:2;SulfoHexCer 42:3(1OH)	1.45	0.98	7.8E-03	4.6E-01	-2.5	0.1
TG 56:3	0.80	1.75	3.1E-02	6.5E-06	1.9	-4.6

TG 56:4	1.02	1.22	4.2E-01	7.5E-03	-0.2	-2.5
TG 56:5	1.26	1.26	5.5E-03	3.6E-03	-2.6	-2.7
TG 56:6	0.71	1.81	3.9E-03	2.0E-04	2.8	-3.7
TG 58:6	0.89	1.55	1.6E-01	2.5E-03	1.0	-2.9

Table 29. List of all quantified lipids with UHPSFC/MS measurement together with fold changes, p-values, and T-values.

Lipid	Fold change		p-value		T-value	
	M	F	M	F	M	F
CE 16:1	1.52	0.85	2.6E-03	7.2E-02	-2.9	1.5
CE 16:0	1.02	1.07	3.9E-01	2.5E-01	-0.3	-0.7
CE 18:3	0.78	0.68	8.2E-03	2.7E-04	2.5	3.6
CE 18:2	0.93	0.86	3.3E-02	3.5E-03	1.9	2.8
CE 18:1	1.19	0.98	7.9E-03	4.1E-01	-2.5	0.2
CE 18:0	0.50	0.87	8.3E-05	2.3E-01	4.3	0.7
CE 20:5	0.60	0.71	3.5E-02	1.5E-02	1.9	2.2
CE 20:4	0.97	0.97	3.3E-01	3.8E-01	0.5	0.3
CE 20:3	0.97	0.83	3.9E-01	9.0E-02	0.3	1.4
CE 20:2	0.77	0.86	3.9E-03	9.1E-02	2.8	1.4
CE 22:6	0.91	1.11	1.7E-01	1.7E-01	1.0	-1.0
CE 22:5	1.45	0.88	1.9E-03	2.0E-01	-3.0	0.9
TG 44:2	1.09	1.40	4.3E-01	1.2E-01	-0.2	-1.2
TG 44:1	1.22	1.39	3.5E-01	2.8E-01	-0.4	-0.6
TG 44:0	0.34	1.41	2.3E-01	3.7E-01	0.8	-0.3
TG 46:3	0.71	1.31	2.3E-01	1.6E-01	0.8	-1.0
TG 46:2	0.94	1.16	4.4E-01	2.5E-01	0.2	-0.7
TG 46:1	1.19	1.20	3.2E-01	1.9E-01	-0.5	-0.9
TG 46:0	1.27	1.27	2.6E-01	1.7E-01	-0.6	-1.0
TG 47:2	0.80	1.16	2.5E-01	2.4E-01	0.7	-0.7
TG 47:1	0.98	1.23	4.8E-01	1.2E-01	0.1	-1.2
TG 47:0	1.08	1.30	4.2E-01	9.5E-02	-0.2	-1.3
TG 48:4	0.58	1.17	4.9E-02	2.0E-01	1.7	-0.9
TG 48:3	0.70	1.02	9.8E-02	4.6E-01	1.3	-0.1
TG 48:2	1.03	1.02	4.5E-01	4.4E-01	-0.1	-0.1
TG 48:1	1.20	1.11	2.3E-01	3.0E-01	-0.7	-0.5
TG 48:0	1.29	1.24	1.7E-01	1.7E-01	-1.0	-1.0
TG 49:3	0.76	1.15	1.3E-01	1.7E-01	1.2	-1.0
TG 49:2	0.90	1.14	3.3E-01	1.8E-01	0.5	-0.9
TG 49:1	1.01	1.25	4.9E-01	9.4E-02	0.0	-1.3
TG 50:5	0.52	1.14	1.2E-02	1.9E-01	2.4	-0.9
TG 50:4	0.66	1.01	1.9E-02	4.8E-01	2.2	0.0
TG 50:3	0.89	1.04	2.3E-01	3.5E-01	0.8	-0.4
TG 50:2	1.29	1.18	4.5E-02	6.5E-02	-1.7	-1.5
TG 50:1	1.42	1.36	1.2E-02	9.7E-03	-2.3	-2.4

TG 51:6	1.20	1.11	3.9E-02	1.0E-01	-1.8	-1.3
TG 51:5	1.18	1.37	5.4E-02	7.9E-04	-1.7	-3.3
TG 51:4	0.65	1.32	9.0E-03	1.2E-02	2.5	-2.3
TG 51:3	0.87	1.21	2.0E-01	3.2E-02	0.9	-1.9
TG 51:2	1.10	1.29	2.9E-01	1.2E-02	-0.6	-2.3
TG 51:1	1.05	1.45	4.2E-01	9.3E-03	-0.2	-2.4
TG 52:7	0.44	1.30	1.6E-02	9.7E-02	2.3	-1.3
TG 52:6	0.51	1.16	7.3E-03	1.6E-01	2.6	-1.0
TG 52:5	0.65	1.08	9.1E-03	2.9E-01	2.5	-0.6
TG 52:4	0.83	1.16	7.8E-02	7.4E-02	1.5	-1.5
TG 52:3	1.05	1.26	3.0E-01	5.6E-03	-0.5	-2.6
TG 52:2	1.31	1.33	3.9E-03	9.6E-04	-2.8	-3.2
TG 52:1	1.07	1.52	3.7E-01	9.6E-03	-0.3	-2.4
TG 52:0	1.00	1.35	5.0E-01	4.1E-03	0.0	-2.7
TG 53:5	0.91	1.46	2.4E-01	1.6E-04	0.7	-3.7
TG 53:4	0.79	1.32	8.7E-02	1.1E-02	1.4	-2.3
TG 53:3	0.99	1.34	4.6E-01	2.2E-03	0.1	-2.9
TG 53:2	1.11	1.41	2.4E-01	4.5E-04	-0.7	-3.4
TG 54:8	0.39	1.23	4.3E-03	1.9E-01	2.8	-0.9
TG 54:7	0.54	1.24	7.6E-03	1.0E-01	2.6	-1.3
TG 54:6	0.72	1.35	2.4E-02	1.4E-02	2.1	-2.2
TG 54:5	0.88	1.32	1.9E-01	9.4E-03	0.9	-2.4
TG 54:4	0.99	1.34	4.8E-01	5.6E-03	0.0	-2.6
TG 54:3	1.23	1.45	8.1E-02	4.2E-04	-1.4	-3.5
TG 54:2	1.23	1.56	9.7E-02	5.5E-04	-1.3	-3.4
TG 54:1	0.73	1.58	1.3E-01	3.2E-02	1.2	-1.9
TG 54:0	0.93	1.66	3.0E-01	3.2E-06	0.5	-4.8
TG 55:6	1.15	1.62	1.4E-01	1.5E-06	-1.1	-4.9
TG 55:4	0.95	1.61	3.6E-01	5.3E-05	0.4	-4.0
TG 55:3	1.08	1.61	2.9E-01	8.2E-06	-0.6	-4.5
TG 56:9	0.46	1.35	2.6E-03	5.0E-02	3.0	-1.7
TG 56:8	0.62	1.53	1.3E-02	2.4E-03	2.4	-2.9
TG 56:7	0.79	1.52	7.6E-02	7.0E-04	1.5	-3.3
TG 56:6	1.04	1.51	3.7E-01	2.2E-04	-0.3	-3.6
TG 56:5	1.38	1.68	3.4E-03	1.3E-05	-2.8	-4.4
TG 56:4	1.14	1.30	1.7E-01	9.7E-03	-1.0	-2.4
TG 56:3	1.08	1.39	3.1E-01	7.3E-03	-0.5	-2.5
TG 56:2	0.76	1.19	1.1E-01	1.4E-01	1.3	-1.1
TG 56:1	0.62	1.38	5.6E-02	1.1E-01	1.6	-1.2
TG 58:10	0.58	1.62	1.4E-02	1.4E-03	2.3	-3.1
TG 58:9	0.78	1.64	7.5E-02	1.5E-04	1.5	-3.7
TG 58:8	0.95	1.72	3.7E-01	2.1E-05	0.3	-4.3
TG 58:7	1.11	1.37	1.6E-01	7.7E-05	-1.0	-3.9
TG 58:6	1.35	1.79	2.4E-02	7.2E-06	-2.0	-4.5
TG 58:5	1.33	1.79	2.8E-02	5.7E-06	-2.0	-4.6
DG 34:2	1.06	1.28	3.5E-01	4.1E-02	-0.4	-1.8
DG 34:1	1.23	1.23	8.5E-02	8.1E-02	-1.4	-1.4

DG 34:0	0.67	2.27	4.6E-03	2.5E-08	2.7	-5.8
DG 36:4	0.65	1.38	7.6E-03	3.9E-02	2.6	-1.8
DG 36:3	0.89	1.26	1.6E-01	6.2E-02	1.0	-1.6
DG 36:2	1.20	1.34	9.2E-02	2.6E-02	-1.4	-2.0
Coenzyme Q10	0.70	0.92	1.1E-02	3.2E-01	2.4	0.5
MG 16:0	0.95	1.29	3.0E-01	1.2E-03	0.5	-3.1
MG 18:0	0.88	1.22	2.8E-02	3.6E-04	2.0	-3.5
Cer d40:1	1.07	0.96	2.4E-01	3.5E-01	-0.7	0.4
Cer d42:2	1.63	1.21	5.1E-11	2.3E-02	-7.3	-2.0
Cer d42:1	0.96	0.68	3.0E-01	3.4E-04	0.5	3.6
PC 30:0	1.48	0.79	1.7E-02	4.1E-02	-2.2	1.8
PC O-32:1/P-32:0	1.89	0.88	5.5E-07	1.5E-01	-5.3	1.0
PC 32:2	0.85	0.60	1.5E-01	2.1E-05	1.0	4.4
PC 32:1	2.10	0.98	2.0E-06	4.0E-01	-4.8	0.3
PC 32:0	1.99	1.12	7.7E-13	5.8E-02	-7.9	-1.6
PC O-34:3/P-34:2	1.02	0.62	4.1E-01	7.4E-07	-0.2	5.3
PC O-34:2/P-34:1	1.14	0.67	8.5E-02	4.8E-06	-1.4	4.8
PC 34:3	1.12	0.71	1.0E-01	6.7E-05	-1.3	4.0
PC 34:2	1.28	0.75	1.1E-03	5.2E-05	-3.2	4.1
PC 34:1	1.88	0.96	1.2E-11	2.9E-01	-7.4	0.6
PC O-36:5/P-36:4	1.04	0.83	3.3E-01	2.2E-02	-0.4	2.1
PC O-36:4/P-36:3	1.14	0.78	4.2E-02	2.2E-03	-1.8	3.0
PC O-36:3/P-36:2	1.10	0.61	1.9E-01	3.7E-06	-0.9	4.9
PC 35:2	1.19	0.75	2.3E-02	1.1E-03	-2.0	3.2
PC 35:1	2.05	1.09	3.6E-07	2.2E-01	-5.4	-0.8
PC 36:5	0.97	0.73	4.1E-01	8.0E-04	0.2	3.3
PC 36:4	1.19	0.86	1.9E-02	4.5E-02	-2.1	1.7
PC 36:3	1.34	0.73	2.2E-04	9.5E-05	-3.7	4.0
PC 36:2	1.23	0.76	9.0E-03	3.5E-04	-2.4	3.6
PC 36:1	2.10	1.06	3.6E-06	3.3E-01	-4.7	-0.4
PC O-38:6/P-38:5	1.00	0.82	4.9E-01	8.0E-02	0.0	1.4
PC O-38:5/P-38:4	1.28	0.93	6.0E-04	2.0E-01	-3.4	0.9
PC O-38:4/P-38:3	1.30	0.88	1.6E-04	6.9E-02	-3.8	1.5
PC 37:3	1.29	0.78	9.5E-03	2.1E-02	-2.4	2.1
PC 38:7	1.13	0.89	1.3E-01	1.2E-01	-1.2	1.2
PC 38:6	1.08	0.91	2.5E-01	2.0E-01	-0.7	0.8
PC 38:5	1.04	0.80	3.6E-01	7.1E-03	-0.4	2.5
PC 38:4	1.12	0.94	1.1E-01	2.3E-01	-1.3	0.8
PC 38:3	1.25	0.83	2.4E-02	3.2E-02	-2.0	1.9
PC 38:2	1.68	1.73	1.0E-03	8.4E-04	-3.2	-3.2
PC 40:7	1.11	0.97	1.6E-01	3.8E-01	-1.0	0.3
PC 40:6	1.10	1.13	2.3E-01	1.2E-01	-0.8	-1.2
PC 40:5	1.16	1.05	1.1E-01	2.9E-01	-1.3	-0.6
PC 40:4	1.82	1.18	1.0E-03	1.3E-01	-3.2	-1.2
SM d32:1	1.06	0.74	3.1E-01	8.8E-03	-0.5	2.5
SM d34:2	1.17	0.91	5.0E-03	1.4E-01	-2.7	1.1
SM d34:1	1.55	0.93	9.9E-10	1.9E-01	-6.5	0.9

SM d36:2	1.30	1.15	2.7E-03	1.0E-01	-2.9	-1.3
SM d36:1	1.49	1.16	1.2E-07	5.7E-02	-5.5	-1.6
SM d38:1	0.96	0.74	2.9E-01	2.0E-03	0.6	3.0
SM d40:2	0.96	0.73	2.7E-01	6.9E-04	0.6	3.4
SM d40:1	0.90	0.70	6.7E-02	7.1E-05	1.5	4.1
SM d41:2	0.92	0.69	2.0E-01	1.1E-03	0.9	3.2
SM d41:1	0.70	0.55	9.2E-05	1.6E-06	4.1	5.1
SM d42:3	1.35	0.96	5.3E-06	3.2E-01	-4.7	0.5
SM d42:2	1.50	0.98	1.0E-08	3.9E-01	-6.1	0.3
SM d42:1	0.77	0.61	8.3E-04	2.6E-07	3.4	5.6

Table 30. List of all quantified lipids with MALDI-MS measurement together with fold changes, p-values, and T-values.

Lipid	Fold change		p-value		t-value	
	M	F	M	F	M	F
cholesterol sulfate	1.02	1.21	4.5E-01	1.6E-01	-0.1	-1
cholesterol sulfate (OH)	1.06	1.69	4.3E-01	6.0E-02	-0.2	-1.6
SM 32:1	0.86	1.01	1.9E-01	4.7E-01	0.9	-0.1
SM 33:2	1.45	1.31	1.3E-01	1.7E-01	-1.2	-1
SM 33:1	1.04	1.24	4.2E-01	1.7E-01	-0.2	-1
SM 34:2	1.12	1.06	2.6E-01	3.6E-01	-0.7	-0.4
SM 34:1	1.19	1.26	1.7E-01	8.0E-02	-1	-1.5
SM 34:0	1.13	1.23	2.7E-01	1.5E-01	-0.7	-1.1
SM 35:1	1.15	1.3	2.8E-01	1.0E-01	-0.6	-1.4
SM 36:2	1.19	1.16	1.8E-01	2.3E-01	-1	-0.8
SM 36:1	1.24	1.35	1.3E-01	6.0E-02	-1.2	-1.6
SM 36:0	1.42	2	4.8E-02	4.0E-02	-1.8	-1.9
SM 37:1	1.08	1.37	3.9E-01	1.6E-01	-0.3	-1
SM 38:1	0.9	1.03	2.9E-01	4.4E-01	0.6	-0.2
SM 39:1	0.57	0.81	1.7E-02	2.6E-01	2.3	0.7
SM 40:3	1.19	1.43	2.8E-01	9.5E-02	-0.6	-1.4
SM 40:2	0.94	1.02	3.7E-01	4.7E-01	0.4	-0.1
SM 40:1	0.86	0.98	2.1E-01	4.6E-01	0.9	0.1
SM 41:3	1.42	1.26	1.2E-01	1.9E-01	-1.3	-0.9
SM 41:2	0.84	0.99	2.2E-01	4.8E-01	0.8	0.1
SM 41:1	0.68	0.85	2.8E-02	2.6E-01	2.1	0.7
SM 42:4	1.16	1.17	2.7E-01	2.7E-01	-0.6	-0.6
SM 42:3	1.19	1.19	2.1E-01	1.8E-01	-0.9	-1
SM 42:2	1.19	1.28	2.1E-01	9.0E-02	-0.9	-1.4
SM 42:1	0.83	0.92	1.7E-01	3.3E-01	1	0.5
SM 43:2	1.27	1.56	2.5E-01	1.0E-01	-0.7	-1.4
SM 43:1	1.05	0.96	2.5E-01	3.7E-01	-0.7	0.4
SulfoHexCer 34:2	1.43	0.9	2.5E-01	3.9E-01	-0.7	0.3
SulfoHexCer 34:1	0.81	0.92	1.8E-01	3.7E-01	1	0.3

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SulfoHexCer 34:2 (OH)	0.86	0.87	3.7E-01	3.7E-01	0.4	0.4
SulfoHexCer 35:1	0.63	1.02	2.8E-03	4.7E-01	3.1	-0.1
SulfoHexCer 34:1 (OH)	0.76	0.93	9.0E-02	3.7E-01	1.4	0.3
SulfoHexCer 35:0	0.78	1.23	1.9E-01	2.5E-01	0.9	-0.7
SulfoHexCer 34:0 (OH)	0.58	0.93	4.1E-02	4.3E-01	1.9	0.2
SulfoHexCer 37:2	0.96	0.96	3.5E-01	3.3E-01	0.4	0.5
SulfoHexCer 37:1	0.62	1.1	4.2E-03	3.6E-01	2.9	-0.4
SulfoHexCer 38:1	1.04	1.13	4.0E-01	2.3E-01	-0.3	-0.8
SulfoHexCer 38:1 (OH)	0.94	1.11	3.3E-01	3.5E-01	0.5	-0.4
SulfoHexCer 40:2	0.79	0.86	1.6E-01	3.3E-01	1.1	0.5
SulfoHexCer 40:1	0.47	0.79	1.0E-02	2.6E-01	2.6	0.7
SulfoHexCer 40:2 (OH)	0.75	0.94	1.6E-01	4.4E-01	1.1	0.2
SulfoHexCer 41:1	0.73	0.76	6.5E-02	1.9E-01	1.6	0.9
SulfoHexCer 40:1 (OH)	0.47	0.74	4.8E-03	1.6E-01	2.9	1
SulfoHexCer 42:3	1.03	1.11	4.7E-01	4.0E-01	-0.1	-0.3
SulfoHexCer 42:2	0.8	0.96	2.1E-01	4.5E-01	0.9	0.1
SulfoHexCer 41:2 (OH)	0.8	1.08	1.7E-01	4.3E-01	1	-0.2
SulfoHexCer 42:1	0.63	0.74	6.5E-02	2.1E-01	1.6	0.8
SulfoHexCer 41:1 (OH)	0.38	0.74	2.7E-03	2.2E-01	3.2	0.8
SulfoHexCer 42:3 (OH)	1.02	0.98	4.8E-01	4.8E-01	0	0.1
SulfoHexCer 42:2 (OH)	0.69	0.89	3.5E-02	3.0E-01	1.9	0.5
SulfoHexCer 42:1 (OH)	0.56	0.76	1.0E-02	1.7E-01	2.5	1
SulfoHexCer 42:1 (2OH)	0.75	1.17	2.0E-01	3.5E-01	0.9	-0.4
PI 34:2	0.9	2.78	4.0E-01	3.2E-02	0.3	-2
PI 34:1	0.82	2.25	2.8E-01	5.0E-02	0.6	-1.8
PI 36:4	0.81	2.61	2.4E-01	4.5E-02	0.7	-1.8
PI 36:3	0.89	2.2	2.9E-01	5.5E-02	0.6	-1.8
PI 36:2	1.02	1.84	4.8E-01	4.9E-02	-0.1	-1.8
PI 36:1	0.56	1.89	5.0E-02	8.5E-02	1.8	-1.5
PI 38:5	0.79	2.11	4.2E-02	4.4E-02	1.9	-1.9
PI 38:4	1.09	1.9	3.7E-01	4.0E-02	-0.4	-1.9
PI 38:3	1.16	1.98	3.1E-01	6.0E-02	-0.5	-1.7
GM3 34:1	1.35	2.04	1.7E-01	1.2E-04	-1	-4.7
GM3 40:1	1.07	1.35	3.3E-01	1.4E-01	-0.5	-1.1
GM3 42:2	1.55	2.26	9.5E-02	7.5E-03	-1.4	-2.7

Table 31. Assignment of human male subjects with unknown classification based on 4 statistical models (#1 OPLS-DA of shotgun MS, #2 OPLS-DA of UHPSFC/MS, #3 OPLS-DA of all data, and #4 SVM of all data) and the average of all 4 models used for the final assignment (N = normal, T = tumor, T1, T2, T3, T4 = tumor stages (T1, T2 are early tumor stages), Tx = tumor but stage is not reported). Real state = health state/diagnosis confirmed by standard examination methods (imaging and/or biopsy).

Sample No.	Final prediction	Real state	Model 1	Model 2	Model 3	Model 4	Average of 4 models
21	T	Tx	1.00	1.00	1.00	0.99	1.00

29	T	T4	0.99	1.00	1.00	1.00	1.00
40	N	N	0.19	0.23	0.23	0.08	0.18
44	N	N	0.15	0.36	0.18	0.12	0.20
46	N	N	0.26	0.22	0.26	0.13	0.22
50	N	N	0.33	0.15	0.27	0.61	0.34
64	(T)	T4	0.31	0.89	0.40	0.66	0.57
89	T	Tx	0.76	0.70	0.80	0.89	0.79
106	T	T3	1.00	1.00	0.99	1.00	1.00
110	T	T3	0.66	0.44	0.58	0.96	0.66
115	N	N	0.14	0.48	0.14	0.32	0.27
118	N	N	0.37	0.36	0.34	0.09	0.29
120	N	N	0.11	0.42	0.11	0.08	0.18
133	T	Tx	0.95	0.73	0.91	1.00	0.90
142	T	T3	0.97	0.81	0.95	1.00	0.93
149	N	T2	0.37	0.39	0.38	0.27	0.35
166	N	N	0.44	0.30	0.45	0.43	0.41
168	N	N	0.21	0.48	0.23	0.19	0.28
173	N	N	0.09	0.46	0.15	0.03	0.18
177	(N)	N	0.54	0.38	0.59	0.28	0.45
184	T	T1	0.87	0.93	0.90	0.95	0.91
194	T	Tx	0.82	1.00	0.89	0.99	0.93
203	T	T3	1.00	0.83	1.00	1.00	0.96
247	T	Tx	0.62	0.92	0.61	0.73	0.72
251	T	T3	1.00	0.65	1.00	0.99	0.91
255	T	T4	0.81	0.97	0.89	0.98	0.91
258	T	Tx	1.00	1.00	1.00	1.00	1.00
264	T	T2	0.68	0.69	0.60	0.84	0.70
267	T	Tx	1.00	1.00	1.00	1.00	1.00
271	T	T4	1.00	1.00	1.00	1.00	1.00
275	T	T3	0.98	1.00	1.00	1.00	1.00
305	T	T4	0.92	0.96	1.00	1.00	0.97
310	T	Tx	0.83	0.81	0.85	1.00	0.87
317	T	Tx	1.00	1.00	1.00	1.00	1.00
322	T	T3	1.00	1.00	1.00	1.00	1.00
347	T	T3	1.00	0.71	1.00	0.97	0.92
351	T	T3	0.85	0.74	0.90	0.95	0.86
355	T	Tx	0.94		0.73		0.84

Table 32. Assignment of human female subjects with unknown classification based on 4 statistical models (#1 OPLS-DA of shotgun MS, #2 OPLS-DA of UHPSFC/MS, #3 OPLS-DA of all data, and #4 SVM of all data) and the average of all 4 models used for the final assignment (N = normal, T = tumor, T1, T2, T3, T4 = tumor stages, Tx = tumor but stage is not reported). Real state = health state/diagnosis confirmed by standard examination methods (imaging and/or biopsy).

Sample No.	Final prediction	Real state	Model 1	Model 2	Model 3	Model 4	Average of 4 models
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17	T	T1	0.89	1.00	0.88	1.00	0.94
25	T	T4	1.00	1.00	1.00	1.00	1.00
34	T	T3	1.00	0.98	1.00	0.99	0.99
55	T	T4	1.00	0.90	1.00	1.00	0.97
68	T	Tx	0.92	1.00	1.00	1.00	0.98
73	T	T3	0.85	1.00	0.89	0.99	0.93
78	T	Tx	0.82	0.71	0.68	0.95	0.79
83	T	T3	1.00	1.00	1.00	1.00	1.00
93	T	T4	1.00	1.00	1.00	1.00	1.00
98	T	T3	1.00	1.00	1.00	1.00	1.00
104	N	Tx	0.16	0.52	0.40	0.23	0.33
125	T	T3	1.00	0.75	1.00	1.00	0.94
130	T	T3	0.94	1.00	1.00	0.86	0.95
157	T	T4	0.61	0.49	0.51	0.96	0.64
161	T	Tx	0.92	0.68	0.72	0.88	0.80
181	T	Tx	0.96	1.00	1.00	0.96	0.98
190	T	T3	0.65	0.97	0.67	0.56	0.71
199	N	T2	0.47	0.52	0.44	0.11	0.38
208	T	T4	0.76	0.73	0.96	0.97	0.85
218	T	T2	0.98	0.87	0.89	1.00	0.93
226	N	N	0.13	0.32	0.22	0.21	0.22
230	N	N	0.25	0.36	0.25	0.02	0.22
235	N	N	0.36	0.00	0.31	0.07	0.19
239	(N)	N	0.64	0.30	0.48	0.40	0.46
280	(T)	T3	0.33	0.70	0.47	0.56	0.51
283	N	N	0.41	0.19	0.30	0.59	0.37
288	N	N	0.16	0.55	0.35	0.22	0.32
292	N	N	0.15	0.00	0.00	0.03	0.04
293	N	N	0.00	0.02	0.00	0.01	0.01
296	N	N	0.27	0.19	0.20	0.13	0.20
327	N	N	0.13	0.08	0.11	0.21	0.13
331	T	N	0.76	0.33	0.73	0.82	0.66
335	N	N	0.00	0.00	0.00	0.00	0.00
344	T	Tx	1.00	1.00	1.00	0.99	1.00
359	T	Tx	0.59	0.64	0.61	0.54	0.59

Calculation of sample throughput for early screening and monitoring of therapy of pancreatic cancer patients based on the lipidomic analysis of human serum, plasma, urine or other body fluids

- 5 Calculation for 100 samples of human serum (plasma, urine, or other type of body fluid)

Instrumentation:

- 1 MS system (shotgun MS, UHPSFC/MS, or MALDI-MS)

- laboratory for sample preparation in Biological Safety Level (BSL) 2 regime

Table 33. Time calculation of individual steps in our methodology for high-throughput lipidomic quantitation

Step	Time [days]	Comments
Sample preparation (liquid/liquid extraction)	1.5	10-12 hours for 1 person
Analysis (including continuous measurement control)	2.5	2 injections = 40 samples/24 hours, 1 injection = 80 (possible 2. injection in case of positive results or ambiguity)
Data processing (noise reduction and data conversion)	1	In fact, it is 2.5 days, but it runs in parallel with the analysis
Quantitation using Microsoft Excel script	0.75	
Multivariate data analysis (MDA)	0.25	
Spare time for unexpected circumstances	1	
TOTAL	7	

Calculation for 1000 samples of human plasma:

- 5 $7 * 10 = 70$ working days - reduction due to some multiplexing and possible over weekend automated operation = ca. 3 months

How many samples per year for 1 MS system:

1000 (per 3 months) * 4 = ca. 4000 samples/year

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Further automation of sample preparation, data processing, multiplexing of tasks, and shortening the analysis time could further increase the sample throughput at least two times.

Industrial Applicability

- 15 The method of the invention can be used for population screening of the whole population or selected population groups based on risk factors such as age, gender, body-mass-index, genetic predispositions, risk behavior, etc. The subjects having the positive output from population screening above a pre-determined threshold can then be subjected to further examinations and tests (e.g., computer tomography or other advanced imaging methods). As the present screening method is non-invasive, can be performed
- 20 in a high-throughput mode, and can detect early stages of cancers, it is the first known method suitable for routine screening of various cancer types including the early stages. The analytical methodology is fully validated in line with recommendations of authoritative organizations, such Food and Drug Administration or European Medicines Agency (EMA).

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1. A method of diagnosing cancer based on lipidomic analysis of a body fluid taken from the body of a patient, wherein the body fluid is selected from serum, plasma, blood, urine, and wherein the cancer is pancreatic cancer or kidney cancer, characterized in that said method comprises the steps of:
 - spiking of a sample of the body fluid with a set of internal standards comprising at least one internal standard for each lipid class present in the sample,
 - subsequently processing the sample by liquid-liquid lipidomic extraction or by solid phase lipidomic extraction,
 - measurement of the processed sample by a mass spectrometry method,
 - determining concentrations for at least 51 lipids, more preferably for all lipids present at a level above detection threshold of the mass spectrometry method, using the internal standards for the corresponding lipid classes for the quantitation, or using relative concentrations, or using ratios of concentrations and/or signal intensities,
 - statistical evaluation of the determined concentrations of the lipids, said statistical evaluation determining the level of probability of the patient suffering from kidney or pancreatic cancer, based on the determined lipid concentrations compared to a specific cancerous pattern, and a non-cancerous pattern, wherein the specific cancerous pattern and the non-cancerous pattern are determined by statistical analysis of the lipid concentrations for a group of known cancer samples and non-cancer samples, and wherein the statistical evaluation is done separately for males and females.

2. The method according to claim 1, wherein the at least 51 lipids include the following lipids:

Sphingolipids					
Cer 34:1	SM 34:2	SM 40:1	SM 42:2	Sul 40:1	Sul 42:1
Cer 42:1	SM 36:1	SM 40:2	SM 42:3	Sul 40:1(OH)	Sul 42:1(2OH)
Cer 40:1	SM 36:2	SM 41:1	SM 43:1	Sul 40:2(OH)	Sul 42:1(OH)
Cer 42:2	SM 38:1	SM 41:2	Sul 34:0(OH)	Sul 41:1	
SM 34:1	SM 39:1	SM 42:1	Sul 34:2(OH)	Sul 41:1(OH)	
Glycerophospholipids					
LPC 16:0	LPC 18:2	PC 34:1	PC 36:3	PC O-34:2/P-34:1	PC O-36:5/P-36:4
LPC 18:0	PC 32:0	PC 34:2	PC 36:4	PC O-34:3/P-34:2	PE 34:1
LPC 18:1	PC 32:2	PC 36:2	PC 38:4	PC O-36:3/P-36:2	
Glycerolipids					
TG 49:1	TG 50:4	TG 50:5	TG 51:4	TG 53:4	TG 55:5

3. A method of diagnosing cancer, wherein pancreatic cancer is diagnosed based on lipidomic analysis of a body fluid taken from the body of a patient, wherein the body fluid is selected from serum, plasma, blood, urine, characterized in that it comprises the steps of:

- spiking of a sample of the body fluid with a set of internal standards comprising at least one internal standard for each lipid class present in the sample,
- subsequently processing the sample by liquid-liquid lipidomic extraction,
- measurement of the processed sample by a mass spectrometry method,
- determining concentrations for at least 31 lipids, more preferably for all lipids present at a level above detection threshold of the mass spectrometry method, using the internal standards for the corresponding lipid classes for the quantitation, or using relative concentrations of lipids, or using ratios of concentrations and/or signal intensities,
- statistical evaluation of the determined concentrations of the lipids, said statistical evaluation determining the level of probability of the patient suffering from pancreatic cancer based on the determined lipid concentrations compared to a pancreatic cancerous pattern and a non-cancerous pattern, wherein the pancreatic cancerous pattern and the non-cancerous pattern are determined by statistical analysis of the lipid concentrations for a group of known pancreatic cancer samples and non-cancer samples, and wherein the statistical evaluation is done separately for males and females.

4. The method according to claim 3, wherein the at least 31 lipids include:

Lipid
HexCer d18:1/16:0; HexCer d18:1/15:1 (1OH)
SM 34:1
HexCer d18:1/24:1; HexCer d18:1/23:2 (1OH)
PE 34:1; PE P-35:0
PC 32:0; PC O-33:0
PE 36:4; PE P-37:3
PC 34:1; PC P-35:0
PE 34:2; PE P-35:1
PC P-34:0; PC 33:1
DG 36:2
Cer d18:1/24:1; Cer d18:1/23:2 (1OH)
CE 16:0
SM 41:1
SM 41:2
PC 34:4; PC P-35:3
HexCer d18:1/24:0; HexCer d18:1/23:1 (1OH)
PE P-36:3; PE 35:4
PE P-38:4; PE 37:5
PE P-38:5; PE 37:6
PE P-36:2; PE 35:3
SM 32:1
HexCer d18:1/22:0; HexCer d18:1/21:1 (1OH)

PE P-38:3; PE 37:4
PC P-38:2; PC 37:3
PE P-40:5; PE 39:6
PE 36:0; PE P-38:6
PE 38:0; PE P-40:6, PE O-39:0
PE P-36:3; PE 35:4
PC P-34:1; PC 33:2
PC P-36:2; PC 35:3
DG 34:3

5. The method according to any one of the preceding claims, wherein the patient is a mammal, preferably a human.

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6. The method according to any one of the preceding claims, wherein the internal standards are exogenous lipid compounds, having the polar head structure typical for the relevant lipid class and containing fatty acyls with shorter chains than naturally occurring lipids, preferably chains 12:0 or 14:0, or fatty acyls with odd number of carbon atoms, preferably chains 17:0, 17:1 or 19:1, or the internal standards are isotopically labelled analogues of the lipids of the relevant lipid class, preferably D7-Chol, D7-CE 16:0.

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7. The method according to any one of the preceding claims, wherein a set of internal standards contains:

D7-CE 16:0	MG 19:1
Cer d18:1/12:0	PA 14:0/14:0
DG 12:1/12:1	PC 14:0/14:0
Hex2Cer d18:1/12:0	PE 14:0/14:0
HexCer d18:1/12:0	PG 14:0/14:0
D7-Chol	PS 14:0/14:0
LPC 17:0	SM d18:1/12:0
LPE 14:0	SulfoHexCer d18:1/12:0
LPG 14:0	TG 19:1/19:1/19:1
LPA 14:0	LPS 17:1

8. The method according to any one of the preceding claims, wherein the mass spectrometry method is selected from shotgun mass spectrometry, ultrahigh-performance liquid chromatography – mass spectrometry, ultrahigh-performance supercritical fluid chromatography – mass spectrometry, and matrix-assisted laser desorption/ionization mass spectrometry.

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9. The method according to any one of the preceding claims, wherein a pooled sample prepared by mixing identical volumes of several samples is used and processed in the same way as the measured samples,

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wherein the pooled sample includes samples from pancreatic cancer patients and healthy volunteers, and wherein the pooled sample is used for observing intra-day accuracy and intra-day precision, and/or for inter-day accuracy and inter-day precision, and/or for determining the lower limit of quantitation and the upper limit of quantitation, and/or for quality control during measurements of sample set.

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10. The method according to any one of the preceding claims, wherein the order of samples is randomized in sample measurement sequences.

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11. The method according to any one of the preceding claims, wherein the step of determining concentrations for all lipids present at a level above lower limit of quantitation of the mass spectrometry method, using the internal standards for the corresponding lipid classes for the quantitation, comprises one or more of the following procedures and corrections:

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- isotopic correction,
- zero filling procedure in which the signals of lipid species which are not detected for particular sample are replaced by 50 to 100 %, preferably by 60 to 100% or by 70 to 100 %, more preferably by 80 to 90 %, or by 80 %, of the minimum concentration observed for said lipid species in all samples.

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12. The method according to any one of the preceding claims, wherein the statistical evaluation involves

- data pre-processing such as centering, scaling, and/or transformation;
- PCA analysis for identification of influential factors such as outliers or measurement failures,
- discrimination analysis by OPLS-DA for group separation of pancreatic cancer patients and healthy volunteers, preferably performed for males and females separately,
- assignment of the statistical parameters as well as the evaluation of the prediction power.

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