that do not receive any specific feed supplements) but also relative to the milk composition described in EP-A-1 106 077, can be obtained with specific requirements to the fatty acid composition, while in addition said milk can easily be produced by an animal, without negatively affecting the animal's health.

In a first aspect, there is provided fatty acids comprising milk composition, preferably a fatty acids comprising cow milk composition, having a total content of saturated fatty acids of between 55,0 and 67,0 grams per 100 grams total fatty acids, wherein the weight ratio ω-6/ω-3 fatty acids is between 0,1 and 2,0, the content of $C_{18:3}$-cis 9,12,15 is between 1,0 and 8,0 g/100 g total fatty acids, and wherein the weight ratio fat/protein is between 1,05 and 1,45.

In an embodiment ~~first aspect~~, the present ~~invention~~disclosure therefore relates to a fatty acids comprising milk composition, having a total amount of saturated fatty acids of between 55.0 and 67.0 grams, preferably between 57.00 and 64 grams, per 100 grams total fatty acids, wherein the weight ratio ω-6/ω-3 fatty acids is between 0.1 and 2.0, the content of $C_{18:3}$-cis 9,12,15 is between 1.0 and 8.0 g/100 g total fatty acids, and wherein the weight ratio fat/protein is between 1.05 and 1.45.

The identity and amount of the various fatty acids can be easily determined using conventional gas chromatography techniques. Particularly, the following method is used by the present inventors: milk fat is extracted from milk samples. Fatty acid methyl esters were prepared from fat fractions as described in ISO Standard 15884 (ISO-IDF 2002b). The methyl esters were analyzed according to ISO Standard 15885 (ISO-IDF 2002a) on a Trace GC Ultra chromatograph (Thermo Electron Corporation), using a Varian Fame Select column (100 m x 0.25 mm ID; Varian Inc.). The initial temperature was held at 70°C for 1 minute and raised to 225°C at 3°C/min and held at 225°C for 5 minutes. A volume of 1µl was injected. Each peak was identified and quantified using pure methyl ester samples (Sigma-Aldrich; Larodan). The fatty acids were expressed as a portion of total fat weigth.

As to the fat/protein ratio, it is noted that this weight ratio is the wt.% fat divided by the protein weight percentage in milk, wherein the protein equals the sum of the true protein content and the non-protein nitrogen (N*6.38, as according to the Kjeldahl method). The fat and protein

When in a composition the amount of ω-6 fatty acids, relative to the amount ω-3 fatty acids, is such that the weight ratio of ω-6/ω-3 fatty acids is higher than 2, such a composition may promote the pathogenesis of many diseases including cardiovascular diseases, cancer, inflammatory diseases and autoimmune diseases. In a preferred embodiment, the weight ratio of ω-6/ω-3 fatty acids is between 1.0 and 1.5.

As said, the content of the ω-3 fatty acid $C_{18:3}$-cis 9,12,15 is between 1.0 and 8.0 g/100 g total fatty acids in the milk composition of the present ~~invention~~disclosure, preferably between 1.2 and 4.0, and most preferably between 1.4 and 2.0, such as about 1.5.

In a further preferred embodiment, the milk composition according to the ~~invention~~disclosure contains Conjugated Linoleic Acid (CLA; $C_{18:2}$ trans 11 cis 9) preferentially is an amount of between 0.5 and 4.0 g/100 g total fatty acids, more preferably between 0.6 and 2.5, most preferably between 0.7 and 1.0 g/100 g total fatty acids. CLA is known to have an anti-carcinogenic effect.

Trans fatty acids are not considered particularly healthy and the content of these fatty acids (the sum of $C_{16:1}$ trans 9 + $C_{18:1}$ trans (4+5+6+7+8) + $C_{18:1}$ trans 9 + $C_{18:1}$ trans 10 + $C_{18:1}$ trans 11) is preferably low; that is less than 8 g/100 g total fatty acids, more preferably less than 5 g/100 g total fatty acids.

The only exception is $C_{18:1}$ trans 11. This trans fatty acid may be present in an amount up to 4 g/100 g total fatty acid; preferably between 1 and 3, more preferably between 1.2 and 1.9 g/100 g total fatty acids. This fatty acid can be converted in the human body to $C_{18:2}$ cis 9, trans 11, (CLA)

In yet a further preferred embodiment, the milk composition has a combined content of the fatty acids $C_{12:0}$, $C_{14:0}$ and $C_{16:0}$ between 26.8 and 41.9 g/100 g total fatty acids. The content preferentially of $C_{12:0}$ is between 1.8 and 3.4 g/100 g total fatty acid, preferably between 2.0 and 2.9 g /100 g total fatty acid. The content of $C_{14:0}$ is preferably between 7.0 and 10.5 g/100

g total fatty acid, more preferably between 8.0 and 9.5 g/100 g total fatty acid. The content $C_{16:0}$ is preferably between 18.0 and 28.0 g/100 g total fatty acid, more preferably between 19.0 and 25.0 g/100 g total fatty acid.

Preferably, the milk composition of the present invention has an Atherogenic Index (AI) between 1 and 2.3; more preferably between 1.4 and 1.8, such as about 1.6. The AI index is defined as follows (the sum of the proportion in wt.% of $C_{12:0}$ + $C_{16:0}$ + 4*$C_{14:0}$ in the fat) divided by (the proportion of total unsaturated fats); wherein the proportion of unsaturated fatty acids equals (100% - the proportion of saturated fatty acids). This index is a dietary risk indicator for cardiovascular diseases and is described in more detail by Bobe *et al.* in J. Dairy Sc. 86 (2003), 3122-3127 and by Ulbricht and Southgate in The Lancet 338 (1991), 985-992.

$C_{18:1}$ cis 9 (oleic acid) is an unsaturated ω-9 fatty acid that does not disturb the ω-6/ω-3 weight ratio). Preferably the content of $C_{18:1}$ cis 9 is between 16.0 and 29.0 g/100 g total fatty acid.

$C_{4:0}$ (Butyrate), a fatty acid associated with anti carcinogenic effects is preferably present in an amount between 3.0 and 4.3 g/100 g total fatty acid.

A number of fatty acids may be present in the milk composition of the present ~~invention~~disclosure without having a particular beneficial effect nor having any adverse effect. To this group of fatty acids, the following fatty acids belong: $C_{6:0}$; $C_{8:0}$; $C_{10:0}$; and $C_{18:0}$.

In a further aspect, the present ~~invention~~disclosure relates to the use of the milk composition of the ~~invention~~disclosure for the preparation of a dairy based composition, such as a cheese, a yoghourt, a cream composition, a dessert product and so on. Furthermore, the ~~invention~~disclosure relates to the products produced using the milk composition, and especially those products wherein the fatty acid composition of the milk composition is essentially maintained in the final product. These products are for instance suitable for food and feed applications or for food and feed supplements. In a further aspect, the present disclosure relates to a product based on the milk composition as defined above or obtainable by the use as defined above.

The milk composition according to the present ~~invention~~disclosure can for instance be obtained by adding particular components to a base roughage and/or base concentrate. This base roughage can consist of maize silage and grass silage. The base concentrate can be any type of concentrate and is a conventional feedstuff having a dry matter content higher than 80 wt.% and a crude fat content lower than 10%. Grass and maize silage are typical components of a winter diet for Dutch cows. The ratio of maize silage to grass silage is important because maize mainly contains ω-6 fatty acids ($C_{18:2}$ cis 9,12) while grass mainly contains ω-3 fatty acids ($C_{18:3}$ cis 9,12,15). Feeding a cow too much maize compared to grass will result in a higher (negative for human health) ω-6 to ω-3 ratio in the milk. In the summer fresh grass will be the main roughage of Dutch cows. Fresh grass contains more ω-3 fatty acids than grass silage. In the summer the combination of supplements described will be added to a diet that contains fresh grass as the main roughage. These supplements (and the roughage) are exemplified in the following table A:

Table A

Component	**kg dry matter (DM)**	**fat % (gram crude fat/100gram DM)**	**kg fat intake per day per animal**
Roughage			
Grass silage	12	4.1	0.5
Maize silage	4	3.5	0.1
Concentrate	5	3.1	0.2
Supplements			
(1)unprotected oil	0.2	100	0.2
(2)protected oil	0.15	66	0.1
(3)completely hydrogenated fat	0.2	100	0.2
Total	21.6	6.0%	1.3

(1) Unprotected oil: oil of any type that consist of >30% $C_{18:3}$ cis 9,12,15 (ALA) (*e.g.* linseed oil). Suitable supplements are described in, e.g. EP-A-

1 106 077. This oil is not protected to rumen biohydrogenation.

(2) Rumen protected oil feed supplement containing oil that is encapsulated or otherwise incorporated in a matrix material preferably based on protein; this encapsulated supplement contains >50% oil and this oil consist of > 30% $C_{18:3}$ cis 9, 12, 15, and the protection is such that less than 50 wt.% of the $C_{18:3}$ cis 9, 12, 15 incorporated therein is converted in the area between the mouth and duodenum of the ruminant. This rumen protected supplement is prepared by *e.g.* the method described in EP-A-1 925 211.

(3) Completely hydrogenated fat. Completely hydrogenated oil that after hydrogenation contains >60% $C_{18:0}$ (stearic acid) and < 5 % unsaturated fatty acids; for example completely hydrogenated rapeseed oil, soybean oil, lineseed oil, sunflower oil.

The feed in this ~~invention~~disclosure is composed of a base roughage, base concentrate and specific combination of supplements. A combination of supplements in which, on a fat base, between 20 and 90% of the fat is delivered by (1) an unprotected oil and this oils may comprise > 30% $C_{18:3}$ cis 9,12, 15 and between 10 and 80% of the fat is delivered by a (2) protected oil that may comprise >30% $C_{18:3}$ cis 9,12, 15. Preferably, the combination of supplements contains, on a fat base, between 50% and 80% (1) unprotected oil that consists of >30% $C_{18:3}$ cis 9,12, 15; and between 20% and 50% (2) protected oil that consists of >30% $C_{18:3}$ cis 9,12, 15.

In yet a further preferred embodiment the combination of supplements, on a fat base may comprise between 20% - 90% (1) unprotected oil that consists of >30% $C_{18:3}$ cis 9,12, 15; and between 10% and 80% (2) protected oil that consists of >30% $C_{18:3}$ cis 9,12, 15 and between 10% and 80% (3) completely hydrogenated fat that contains >60% $C_{18:0}$ and < 5 % unsaturated fatty acids. More preferably the combination of supplements, on a fat base consists of between 30% - 70% of (1) unprotected oil that consists of >30% $C_{18:3}$ cis 9,12, 15, between 20% and 50% of (2) protected oil that consists of >30% $C_{18:3}$ cis 9,12, 15 and between 30% and

70% of (3) completely hydrogenated fat that contains >60% $C_{18:0}$ and < 5 % unsaturated fatty acids.

The milk composition obtained as a result of feeding the combination of supplements in the quantities as stated in Table A differs for individual cows and changes during the season. The fatty acid composition is also determined by the health status, lactation stage, parity and genetic background of the cow. Furthermore, the composition and quantity of the fatty acids supplied by the diet is, in addition to the supplements also depending on the fatty acid composition and fat % of the other components in the diet of the cow (*e.g.* the roughage or the concentrate).

As said, especially the composition of the roughage varies greatly during the season. With the information provided the skilled person will however be able to prepare the milk composition according to the ~~invention~~disclosure. In yet a further aspect, the present ~~hence invention~~disclosure relates to a formulation for lactating animals and preferably for dairy cows, based on a conventional roughage; said feed formulation comprising in the fatty phase 20-90 wt.%, preferably 50-80 wt.% (drawn to the fatty phase) native fat comprising at least 30 wt.% $C_{18:3}$ cis 9, 12, 15; and 80-10 wt.%, preferably 50-20 wt.% rumen-protected fat, comprising at least 30 wt.% $C_{18:3}$ cis 9, 12, 15.

In a preferred embodiment, said formulation of the ~~invention~~disclosure comprises at least 10 wt.% of the rumen-protected fat, and in addition at least 10 wt.%, preferably between 30 and 70 wt.%, completely hydrogenated fat, comprising at least 60 wt.% $C_{18:0}$.

Such formulations are generally prepared by adding the essential supplements, optionally in the form of rumen protected compositions, to a conventional base composition. Such a base composition may for instance be silage, and especially a grass silage or a maize silage, yet other suitable base compositions can equally well be used. Preferably, the formulation also contains added minerals and vitamins, and especially added selenium. Preferably, 0.2 mg/kgDM (dry matter) organic selenium is added to the

formulation of the ~~invention~~disclosure and to the composition illustrated in table A. In addition to the level of selenium added, the selenium concentration is also depending on the selenium concentration already present in the other feed components. Organic selenium is partly incorporated in the milk proteins. A higher selenium concentration in dairy products is positive for human health. Furthermore, addition of selenium preferably in combination with vitamin E is beneficial for the oxidative stability of the feed stuff and the milk. This is especially important when the amounts of unsaturated fatty acids are raised, as for the milk according to the invention. Moreover selenium and Vitamin E are important for the cow's health.

Preferably, the selenium content in the milk is between 1.8 and 6.1 µg/100g milk.

The three types of feed supplements used in the present ~~invention~~disclosure will now be discussed:

1) Rumen protected supplements are used to prevent biohydrogenation in the rumen. In this technique a (generally purified) oil is encapsulated, for example with protein. An example is described in EP-A-1 925 211. Advantages of this technique are that an increase in specific fatty acids (*e.g.* ω-3 or ω-6), no or only a limited increase in trans fatty acids, and a small decrease in $C_{12:0}/C_{14:0}/C_{16:0}$ can be obtained.

2) Non rumen protected supplements have as an important advantage that CLA will be formed and the biohydrogenation intermediates will inhibit the *de novo* synthesis of fatty acids in the cow. The *de novo* synthesized fatty acids are saturated fatty acids ($C_{4:0}$-$C_{16:0}$). The oils supplemented in this way are not protected to biohydrogenation which leads to a large decrease in $C_{12:0}/C_{14:0}/C_{16:0}$, to a small increase in polyunsaturated fatty acids, and to a considerable increase in CLA.

3) Hardened fats are completely hydrogenated fats that only contain saturated fatty acids. They are a good source of energy for the cow because saturated fat is not used by rumen bacteria and does not disturb rumen

bacteria metabolism. The addition of saturated fats to the diet of cows will result in an increase of these saturated fatty acids in the milk. However the cow is capable of desaturating saturated fatty acids to delta 9 unsaturated fatty acids by the stearoyl-CoA desaturase (SCD) enzyme, which catalyzes the insertion of a double bond between carbon atoms 9 and 10 of a fatty acid. The extent to which fatty acids are unsaturated by this enzyme depends on the chain length of the fatty acids. For most fatty acids this unsaturation of the saturated precursor is below 50 % indicating that addition of such fatty acids to the diet will result in an increase of the total amount of saturated fat in the milk. However, for $C_{18:0}$ the SCD enzyme desaturates more than 50% of the saturated $C_{18:0}$ to $C_{18:1}$ cis 9. This indicates that addition of saturated $C_{18:0}$ to the milk will result in an increase in the amount of unsaturated fat in the milk. Completely hydrogenated oils that contain mainly C_{18} fatty acids before hydrogenation are a good source of $C_{18:0}$. Hardened oil containing mainly $C_{18:0}$ is a good fat source to increase $C_{18:1}$ cis 9 in milk because $C_{18:1}$ is partly saturated to $C_{18:1}$ cis 9 in the mammary gland.

Stearic acid ($C_{18:0}$), a solid fat at room temperature, can be grinded and fed, mixed with other feed stuff in the ration. Alternatively, stearic acid can be melted and used to coat other feed stuff in the ration. Coating other feed stuff might help to rumen protect these other feed stuff.

In yet a further preferred embodiment, the formulation of the ~~invention~~disclosure contains added selenium. This selenium is partly incorporated in milk proteins and excreted in the milk. A higher selenium level in the milk is good for human health, but also important for the cow's health. Selenium is an antioxidant preventing oxidation of polyunsaturated fatty acids in the milk and in the feed supplement.

A milk composition obtained by milking cows fed with the food composition described in Table A is given in Table B:

This milk composition has an increased amount of ω-3 fatty acids, CLA, oleic acid and preferably also of the mineral selenium that is also preferably added to the roughage. It has a lower content of saturated acids (compared to regular cows' milk) and especially a lower amount of those saturated fatty acids referred to in the AI ($C_{12:0}$, $C_{14:0}$ and $C_{16:0}$). The increase of trans fatty acids is rather limited and is primarily an increase of $C_{18:1}$ trans 11. The food does neither give the animal a negative energy balance nor a milk fat depression. The urea content in the milk composition of the invention is reduced, preferably to an amount in the range of 5-35 mg/100 g milk, and so is the nitrogen excretion in the urine.

In the last aspect, the present ~~invention~~disclosure relates to a process for producing a milk composition according to the ~~invention~~disclosure, comprising feeding a lactating animal, and preferable a cow, with a formulation of the ~~invention~~disclosure, followed by milking said animal.