

## FAT AND OIL COMPOSITION AND METHOD OF PRODUCING THE SAME

BACKGROUND OF THE INVENTION1. Field of the Invention

The present invention relates to edible processed fats and oils. In further detail, it relates to a fat and oil composition as a substitute for hardened fish oil.

2. Description of the Related Art

Hardened fish oil has been widely used as an edible processed fat and oil for years and it holds an important position as a raw material for specialty margarines and shortening. This is based on the fact that hardened fish oil has excellent plasticity and is inexpensive when compared to other animal and vegetable fats and oils and processed fats and oils of the same. However, the catch of small fish (for instance, sardines and mackerel) that are the raw material for fish oil has continued to decrease in size, not only in the coastal waters of Japan, but throughout the world, and cost has also increased, making it difficult to obtain such fish. Under these circumstances, fat and oil compositions with plasticity are being produced using other animal and vegetable fats and oils, but when compared to hardened fish oil, only products that have a very poor broad plasticity range and texture, gloss, and spreadability or whipping performance are obtained.

Making a good cream using fats and oils obtained by interesterification of a combination oil of palm oil and lauric oil and liquid oil (Japanese Laid-Open Patent No. Sho 52-78203), or similarly making a fat and oil composition with plasticity that is compatible with hardened fish oil (Japanese Laid-Open Patent No. Hei 8-242765) have been presented to improve on these disadvantages. Moreover, a method of producing a fat and oil composition with plasticity with which separation of the liquid oil and graining are controlled by the same interesterification has also been presented (Japanese Patent No. Hei ;9-241672). In addition, it has been suggested that fats and oils for baked confections, etc., be improved by using fats and oils containing fatty acids with 20 or more carbons in the random interesterification reaction (for instance, Japanese Laid Open Patents No. Sho 58-94345, No. Hei 4-66045, No. Hei 4-71441, No. Hei 9-224571). Furthermore, it has also been suggested that plasticity, etc., of fat and oil compositions be improved by interesterification reaction of a combination oil of a fat and oil containing a fatty acid with 20 or more carbons, lauric fat and oil, and palm fat and oil, etc. (for instance, Japanese Laid-Open Patents No. Sho 50-26804, No. Sho 54-31407, No. Sho 54-34002, and No. Hei 9-165595).

Nevertheless, these proposals are based on research of improving the plasticity of conventional animal and

vegetable fats and oils, or improving compatibility with hardened fish oil, and although these are effective, they do not surpass hardened fish oil in terms of the extent of the plasticity range and texture, gloss and spreadability or whipping performance and only more valuable fat and oil compositions with plasticity that are obtained by mixing with hardened fish oil have been presented.

Moreover, from a nutritional standpoint, trans-isomers, which are constitutional fatty acids of fats and oils, are being debated, and there is a need for development of fats and oils with a low trans-isomer content. Hydrogenation of fats and oils in the presence of a noble metal, such as palladium, platinum, etc., and sodium methoxide, which is an interesterification catalyst (Japanese Laid-Open Patent No. Hei 7-118688), is an example of the development of a fat and oil with a low trans-acid content, and interesterification of palm oil and rapeseed oil or palm kernel oil and palm super-hardened oil using a 1,3-position-specific lipase (Japanese Laid-Open Patent No. Hei 4-65493) is an example of the development of a fat and oil that does not comprise trans-acid.

Nevertheless, although it is reported that plasticity is improved in all of these cases, there have been no reports of these proposals being advantageous to such an extent that

they can replace hardened fish oil and characteristic evaluation has not been performed.

As previously explained, there is not a known fat and oil composition with the same properties as hardened fish oil that is obtained by current art and that can be used in place of hardened fish oil, and such a fat and oil composition is in demand. Moreover, fats and oils with a low trans-acid content are also in demand.

#### SUMMARY OF THE INVENTION

In light of these circumstances, the inventors of the present invention analyzed the composition of hardened fish oil and found that, assuming that the constitutional fatty acids are randomly arranged, the triglyceride total carbon distribution of hardened fish oil and triglyceride total carbon distribution of fish oil are very similar, and as a result of performing intense studies of the idea that it may be possible to obtain properties that are the same as or better than hardened fish oil if a triglyceride composition similar to hardened fish oil can be obtained based on this knowledge, the inventors successfully completed the fat and oil composition and method of producing the same of the present invention.

That is, the fat and oil composition of the present invention is a mixed random interesterificated fat and oil composition that is a substitute for hardened fish oil and

that has a total saturated fatty acid content, content of saturated fatty acid with 12 or fewer carbons, and content of saturated fatty acid with 20 or more carbons adjusted to within specific ranges, and which has the same slip melting point and penetration value as hardened fish oil.

The first fat and oil composition of the present invention is a mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 48 wt% to 52 wt% containing 12.5 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 4 wt% to 14 wt% saturated fatty acid with 20 or more carbons, wherein the slip melting point is  $29.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  is  $110 \pm 22$ .

The second fat and oil composition of the present invention is a mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 68 wt% to 75 wt% containing 11 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 5 wt% to 20 wt% saturated fatty acids with 20 or more carbons, wherein the slip melting point is  $38.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  is  $25 \pm 5$ .

The third fat and oil composition of the present invention is a mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 79 wt% to 82 wt% containing 12 wt% to 17 wt% saturated fatty

acid with 12 or fewer carbons and 8 wt% to 24 wt% saturated fatty acids with 20 or more carbons, wherein the slip melting point is  $43.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $30^{\circ}\text{C}$  is  $25 \pm 7$ .

In a preferred embodiment of the above-mentioned first through third fat and oil compositions of the present invention, the trans-isomer content as a constitutional fatty acid is 3 wt% or less.

Moreover, the fourth fat and oil composition of the present invention comprises at least 2 selected from the group consisting of the above-mentioned fat and oil compositions.

The slip melting point, fatty acid composition, and trans-isomer content of the present invention are based on Standard Fat and Oil Analysis and Testing Methods (Japan Oil Chemists' Society, editors - 1996). In further detail, the slip melting point is the determination by above-mentioned Analysis and Testing Methods 2.2.4.2 Melting Point (Slip Melting Point), the fatty acid composition is the determination by above-mentioned Analysis and Testing Methods 2.4.2.2 Fatty Acid Compositions (FID -Elevated-Temperature Gas Chromatography Method), and the trans-isomer content is the determination by above-mentioned Analysis and Testing Methods 2.4.4.1 Lone Trans-Isomer (Differential Infrared Spectrum Method).

When the fat and oil is sampled with a capillary tube and solidified under specific conditions and then the capillary tube is immersed in a water bath and the fat and oil is gradually melted by raising water bath temperature at a specific speed under differential pressure of a water column of 30 mm from the bottom of the capillary tube, it gradually slips and begins to slip, and this temperature at which it begins to slip is the slip melting point used here in the present invention. It is closely related to oral melt down of the fat and oil product.

The slip melting point of the fat and oil product has a strong correlation with how the food feels in the mouth when eaten, that is, oral melt down. For instance, if it is too hard at a temperature close to body temperature, it will feel like wax when chewed and be unsuitable as food.

Moreover, the penetration value in the present invention is based on the spreadability testing method of JIS K2220-1993. Here, a cone weighing 102.5 g and a plunger weighing 47.5 g, or a penetration can made of brick with an inner diameter of 57 mm and depth of 25 mm is used. The penetrometer is a digital-type auto-penetrometer (Mitamura Riken Kogyo).

The sample for determination of penetration is prepared as follows:

The fat and oil to be measured is heated to 60°C to 65°C and a piece of ice 5 cm thick is placed level and the molten fat and oil is poured so that it flows over the penetration jar. After solidification over the ice for 1.5 hours, the fat and oil is immersed in a thermostatic water bath at a specific determination temperature and penetration is measured 2 hours later with a penetrometer.

The penetration value is spreadability represented by needle penetration, as previously explained, and is an indicator of hardness at the determination temperature.

Moreover, hardness of the fat and oil product has a strong effect on productivity, when for instance, bread is being kneaded or bread is being spreaded. Hardness of the fat and oil product changes with temperature and therefore, the desired hardness often differs depending on differences in air temperature with seasons and areas and the purpose of use, method of use and environment in which it is used, and together with slip melting point, hardness is very important.

It is difficult to satisfy all of these requirements with just one fat and oil and a variety of fats and oils are being processed and mixed in order to market products with diverse characteristics.

The fact that hardened fish oil is an important raw material for fats and oils has already been mentioned, but even hardened fish oil rarely meets all of the above-

mentioned requirements and a substance with various characteristics is desirable.

The fat and oil composition substitute for hardened fish oil of the present invention will now be described.

First, the properties of the following 3 types of typical hardened fish oils will be discussed:

The first hardened fish oil (referred to as hardened fish oil A below) has a slip melting point of  $29.0 \pm 1.5^{\circ}\text{C}$  and a penetration value at  $20^{\circ}\text{C}$  of  $110 \pm 22$ .

The second hardened fish oil (referred to as hardened fish oil B below) has a slip melting point of  $38.0 \pm 1.5^{\circ}\text{C}$  and a penetration value at  $20^{\circ}\text{C}$  of  $25 \pm 5$ .

The third hardened fish oil (referred to as hardened fish oil C) has a slip melting point of  $43.0 \pm 1.5$  and a penetration value at  $30^{\circ}\text{C}$  of  $25 \pm 7$ .

These hardened fish oil A, hardened fish oil B, and hardened fish oil C can be used alone or combinations of 2 or 3 types can be used, depending on the desired properties of the product for which they will be used, and further, it is also possible to use at least 1 of these hardened fish oils in combination with another animal or vegetable fat and oil or animal and vegetable processed fat and oil.

The fat and oil composition of the present invention can also be used as a substitute fat and oil of above-mentioned hardened fish oils A through C.

To begin, the first fat and oil composition (referred to as fat and oil composition AA below) has properties corresponding to above-mentioned hardened fish oil A and is obtained by random interesterification of a fat and oil mixture with a total saturated fatty acid content of 48 wt% to 52 wt% containing 12.5 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 4 wt% to 14 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $29.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  to  $110 \pm 22$ . This can be used as a substitute fat and oil for hardened fish oil A.

The second fat and oil composition of the present invention (referred to below as fat and oil composition BB) has properties corresponding to above-mentioned hardened fish oil B and is obtained by random interesterification of a fat and oil mixture with a total saturated fatty acid content of 68 wt% to 75 wt% containing 11 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 5 wt% to 20 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $38.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  to  $25 \pm 5$ . It can be used as a substitute fat and oil for hardened fish oil B.

The third fat and oil composition of the present invention (referred to below as fat and oil composition CC) has properties corresponding to above-mentioned hardened fish

oil C and is obtained by random interesterification of a fat and oil mixture with a total saturated fatty acid content of 79 wt% to 82 wt% containing 12 wt% to 17 wt% saturated fatty acid with 12 or fewer carbons and 8 wt% to 24 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $43.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $30^{\circ}\text{C}$  to  $25 \pm 7$ . It can be used as a substitute fat and oil for hardened fish oil C.

With regard to the correlation between the fatty acid composition and the properties of the random interesterified fat and oil, the total saturated fatty acid content has a strong effect. If the total saturated fatty acid content is too low, the slip melting point of the random interesterified fat and oil will be too low and the penetration value will be too high (in other words, needle penetration will be too high and the product will be too soft). Moreover, if the total saturated fatty acid content is too high, the slip melting point of the random interesterified fat and oil will be too high and the penetration value will be too low (needle penetration will be too low and the product will be too hard). The content of saturated fatty acid with 12 or fewer carbons will also have an effect on the slip melting point and penetration value, but it will not have as strong an effect as the total saturated fatty acid content. If the total saturated fatty

acid content and content of saturated fatty acid with 12 or fewer carbons are the same conditions, the content of saturated fatty acid with 20 or more carbons will have a weak effect on the slip melting point and penetration. However, margarine in which random interesterified fat and oils comprising almost no saturated fatty acids with 20 or more carbons is lacking in product quality.

If fat and oil composition AA has a total saturated fatty acid content outside the range of 48 wt% to 52 wt%, a content of saturated fatty acid with 12 or fewer carbons outside the range of 12.5 wt% to 16 wt%, and a content of saturated fatty acid with 20 or more carbons outside the range of 4 wt% to 14 wt%, it will be outside the range of property values of hardened fish oil A (that is, a slip melting point of  $29.0 \pm 1.5^{\circ}\text{C}$  and a penetration value at  $20^{\circ}\text{C}$  of  $110 \pm 22$ ). As a result, there will be inconveniences, such as it being necessary to adjust the mixture ratio when it is substituted for hardened fish oil A as a raw material for margarine or shortening, and this therefore is undesirable. Using random interesterificated fat and oil containing less than 4 wt% saturated fatty acid with more than 20 carbons will not provide satisfactory margarine properties. Moreover, increasing the content of saturated fatty acid with 20 or more carbons to more than 14 wt% will

not provide improved results. Thus, the content of saturated fatty acid with 20 or more carbons must be 4 wt% to 14 wt%.

If fat and oil composition BB has a total saturated fatty acid content outside the range of 68 wt% to 75 wt%, a content of saturated fatty acid with 12 or fewer carbons outside the range of 11 wt% to 16 wt%, and a saturated fatty acid content with 20 or more carbons outside the range of 5 wt% to 20 wt%, it will be outside the range of property values of hardened fish oil B (that is, a slip melting point of  $38.0 \pm 1.5^{\circ}\text{C}$  and a penetration value at  $20^{\circ}\text{C}$  of  $25 \pm 5$ ), and there will be inconveniences in that it will be necessary to modify the mixture ratio when it is used to replace hardened fish oil B as a raw material for margarine and shortening, and this therefore is undesirable. The use of a random interesterificated fat and oil containing less than 5 wt% saturated fatty acid with 20 or more carbons will not provide satisfactory margarine properties. Moreover, increasing the content of saturated fatty acid with 20 or more carbons to more than 20 wt% will not improve the results. Thus, the content of saturated fatty acid with 20 or more carbons must be 5 wt% to 20 wt%.

If fat and oil composition CC has a total saturated fatty acid content outside the range of 79 wt% to 82 wt%, a content of saturated fatty acid with 12 or fewer carbons outside the range of 12 wt% to 17 wt%, and a saturated fatty

acid content with 20 or more carbons outside the range of 8 wt% to 24 wt%, it will be outside the range of property values of hardened fish oil C (that is, a slip melting point of  $43.0 \pm 1.5^{\circ}\text{C}$  and a penetration value at  $30^{\circ}\text{C}$  of  $25 \pm 7$ ), and there will be inconveniences in that it will be necessary to modify the mixture ratio when it is used to replace hardened fish oil C as a raw material for margarine and shortening, and this therefore is undesirable. The use of a random interesterificated fat and oil containing less than 8 wt% saturated fatty acid with 20 or more carbons will not provide satisfactory margarine properties. Moreover, increasing the content of saturated fatty acid with 20 or more carbons to more than 24 wt% will not improve the results. Thus, the content of saturated fatty acid with 20 or more carbons must be 8 wt% to 24 wt%.

The fat and oil composition of the present invention having properties corresponding to hardened fish oil A and a trans-isomer content as constitutional fatty acid of 3 wt% or less (referred to below as fat and oil composition AT) is obtained by random interesterification of a fat and oil composition with a total fatty acid content of 48 wt% to 52 wt% containing 12.5 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 4 wt% to 14 wt% saturated fatty acids with 20 or more carbons and having a trans-isomer content as constitutional fatty acid of 3 wt% or less. It has

properties of a slip melting point of  $29.0 \pm 1.5^{\circ}\text{C}$  and a  $20^{\circ}\text{C}$  penetration value of  $110 \pm 22$ , and it can be used as a substitute fat and oil for hardened fish oil A or fat and oil composition AA.

Moreover, the fat and oil composition of the present invention having properties corresponding to hardened fish oil B and a trans-isomer content as constitutional fatty acid of 3 wt% or less (referred to below as fat and oil composition BT) is obtained by random interesterification of a fat and oil composition with a total fatty acid content of 68 wt% to 75 wt% containing 11 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 5 wt% to 20 wt% saturated fatty acids with 20 or more carbons and having a trans-isomer content as constitutional fatty acid of 3 wt% or less. It has properties of a slip melting point of  $38.0 \pm 1.5^{\circ}\text{C}$  and a  $20^{\circ}\text{C}$  penetration value of  $25 \pm 5$ , and it can be used as a substitute fat and oil for hardened fish oil B or fat and oil composition BB.

Furthermore, the fat and oil composition of the present invention having properties corresponding to hardened fish oil C and a trans-isomer content as constitutional fatty acid of 3 wt% or less (referred to below as CT fat and oil composition) is obtained by random interesterification of a fat and oil composition with a total fatty acid content of 79 wt% to 82 wt% containing 12 wt% to 17 wt% saturated fatty

acid with 12 or fewer carbons and 8 wt% to 24 wt% saturated fatty acids with 20 or more carbons and having a trans-isomer content as constitutional fatty acid of 3 wt% or less. It has properties of a slip melting point of  $43.0 \pm 1.5^{\circ}\text{C}$  and a  $30^{\circ}\text{C}$  penetration value of  $25 \pm 7$ , and it can be used as a substitute fat and oil for hardened fish oil C or fat and oil composition CC.

As with hardened fish oil A, hardened fish oil B, and hardened fish oil C, these fat and oil composition AA, fat and oil composition BB, fat and oil composition CC, fat and oil composition AT, fat and oil composition BT, and fat and oil composition CT can be used alone or two or more can be used in combination with one another, depending on the desired properties of the product for which they will be used, and further, at least one selected from the group consisting of these fat and oil compositions can be used in combination with another animal or vegetable fat and oil or animal or vegetable processed fat and oil.

The raw materials used to obtain fat and oil composition AA, fat and oil composition BB and fat and oil composition CC of the present invention must satisfy the following necessary conditions:

- 1) The raw fat and oil composition used to obtain fat and oil composition AA of the present invention should be a fat and oil selected from fats and oils that will provide a

fat and oil mixture with a saturated fatty acid content of 48 wt% to 52 wt% containing 12.5 to 16 wt% saturated fatty acid with 12 or fewer carbons and 4 wt% to 14 wt% saturated fatty acids with 20 or more carbons.

2) The raw fat and oil composition used to obtain fat and oil composition BB of the present invention should be a fat and oil selected from fats and oils that will provide a fat and oil mixture with a saturated fatty acid content of 68 wt% to 75 wt% containing 11 to 16 wt% saturated fatty acid with 12 or fewer carbons and 5 wt% to 14 wt% saturated fatty acids with 20 or more carbons.

3) The raw fat and oil composition used to obtain fat and oil composition CC of the present invention should be a fat and oil selected from fats and oils that will provide a fat and oil mixture with a saturated fatty acid content of 79 wt% to 82 wt% containing 12 to 17 wt% saturated fatty acid with 12 or fewer carbons and 8 wt% to 24 wt% saturated fatty acids with 20 or more carbons.

Consequently, a fat and oil comprising saturated fatty acids with 12 or fewer carbons and a fat and oil comprising saturated fatty acids with 20 or more carbons is needed in order to obtain any of fat and oil composition AA, fat and oil composition BB and fat and oil composition CC. Fat and oil made from other fatty acids can also be used in order to bring the fatty acid composition to within the desired range.

Coconut oil, palm kernel oil, babassu oil, milk fat, etc., for instance, can be used alone or as mixtures as the raw fat and oil comprising saturated fatty acid with 12 or fewer carbons. Moreover, hydrogenated fat and oil, fractionated fat and oil, hydrogenated fat and oil of fractionated fat and oil, fractionated fat and oil of hydrogenated fat and oil, and interesterificated fat and oil of these fats and oils alone or mixed oils can also be used.

High-erucic rapeseed oil, white mustard oil, sal fat, fish oil, etc., for instance, are fats and oils comprising fatty acids with 20 or more carbons, and hydrogenated fat and oil, fractionated fat and oil of hydrogenated fat and oil, and interesterificated fat and oil of these fats and oils alone or their mixed oils can also be used.

Soybean oil, rapeseed oil, corn oil, rice oil, cottonseed oil, palm oil, beef tallow, lard, etc., can be used alone or as a mixture as the other fat and oil. Moreover, hydrogenated fat and oil, fractionated fat and oil, hydrogenated fat and oil of fractionated fat and oil, fractionated fat and oil of hydrogenated fat and oil, and interesterificated fat and oil of these fats and oils alone or their mixed oils can also be used.

The raw materials used to obtain fat and oil composition AT, fat and oil composition BT, and fat and oil composition CT of the present invention is similar to the raw fat and

oils used to obtain above-mentioned fat and oil composition AA, fat and oil composition BB, and fat and oil composition CC, but it is necessary to select a fat and oil from fats and oils with a trans-isomer content as the constitutional fatty acid of the fat and oil composition of 3 wt% or less. If the trans-isomer content as constitutional fatty acid exceeds 3 wt%, there will be problems in terms of the fact that this content is different from the trans-isomer content of natural fats and oils and it is also different from commercial needs. Although natural fats and oils contain almost no trans-isomer, hydrogenated fats and oils contain, for instance, 30 wt% to 50 wt%. Consequently, when hydrogenated fats and oils are used for the raw materials, the trans-isomer content must be restricted. For instance, when 30 wt% hydrogenated fat and oil is used in a fat and oil mixture that will be random interesterified, the trans-isomer content of the hydrogenated fat and oil must be 10.0 wt% or less. Similarly, when 20 wt% hydrogenated fat and oil is used, the trans-isomer content of the hydrogenated fat and oil must be 15.0 wt%. These trans-isomer content requirements are reproduced for the type of raw oil that will be used as long as the reaction conditions when the hydrogenated fat and oil is made, such as catalyst type, amount of catalyst added, temperature, pressure, etc., are standard conditions, and can

be easily satisfied by specifying the iodine value after hydrogenation is completed.

Next, the method of producing the fat and oil composition of the present invention will be described. By means of the production method of the present invention, the fat and oil mixture before random interesterification has a main fatty acid composition of each of the above-mentioned types of random interesterified fats and oils within a specific range, and it can be prepared by selecting 3 or more types of raw fat and oil and the mixture percentage of each raw fat and oil that satisfy these requirements. There are no special restrictions to the method by which each of the above-mentioned random interesterified fat and oil is obtained and it can be obtained by the method that uses an alkali catalyst, such as sodium methyrate, etc., the method that uses an enzyme such as lipase, and conventional non-selective interesterification methods. As with conventional fat and oil products, the random interesterified fat and oil can be deodorized and used.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be further described with examples and comparative examples, but the present invention is not limited to these examples.

(Examples 1 through 14)

A random interesterification reacted oil (total of 14 types, 7 types of oil composition AA and 7 types of oil composition AT) was made by random interesterification using an oil mixture with a total saturated fat content of 48 wt% to 52 wt%, a content of saturated fatty acid with 12 or fewer carbons of 12.5 wt% to 16 wt%, a content of saturated fatty acid with 20 or more carbons of 4 to 14 wt%, and a trans-isomer content either exceeding 3 wt% or of 3 wt% or less.

The methods and conditions of random interesterification are described below:

Methods and conditions of random interesterification reaction

Raw mixed oil was poured into a random interesterification reaction vessel and dehydrated until it reached 120°C and 30 mmHg by heating under reduced pressure as it was being agitated. Then 0.3 wt% sodium methyleate was added and reacted for 40 minutes in a nitrogen current while agitating. The reaction solution was cooled to 90°C and then pH was brought to 11 or lower by adding aqueous 10% citric acid solution. Agitation was stopped and the product was set aside. The oil layer and aqueous layer separated. So-called warm water rinsing was performed whereby warm water at 90°C was newly added to the oil layer and agitated and then the mixture was set aside so that the oil layer and aqueous layer separated. Warm water rinsing was repeated until pH of the

aqueous layer that had separated became 8 or lower. Then the product was dehydrated until it reached 100°C and 30 mmHg by heating under reduced pressure while agitating. Next, 3 wt% activated clay was added and the mixture was agitated under reduced pressure until it reached 100°C and 30 mmHg. The total volume was filtered 30 minutes later.

There was almost no difference between the fatty acid composition of the random interesterification reacted oil produced in this way and the raw mixed oil that was used.

The triglyceride total carbon distribution of the raw mixed oil and random interesterification reacted oil was determined by gas chromatography and the unreacted percentage was found. The findings with an unreacted percentage exceeding 3 molar% were not included in the data.

The unreacted percentage was an approximation by the least squares method with random interesterification reacted oil consisting of balanced triglycerides, balanced diglycerides, and unreacted triglycerides based on the triglyceride total carbon composition of the raw mixed oil and random interesterification reacted oil.

The raw fat and oil mixture (mixture percentage in wt%) and fatty acid composition and properties of the random interesterification reacted oil are shown in Table 1.

Table 1.

|                                        | Example No.                                              | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   |
|----------------------------------------|----------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                                        | Random interesterification reacted oil name              | AA-1 | AA-2 | AA-3 | AA-4 | AA-5 | AA-6 | AA-7 | AT-1 | AT-2 | AT-3 | AT-4 | AT-5 | AT-6 | AT-7 |
| Raw fat and oil mixture percentage (%) | Coconut oil                                              | 21.7 | 26.0 | 22.5 | 27.7 | 24.3 | 24.3 | 24.2 | 21.6 | 25.9 | 22.4 | 27.7 | 24.2 | 24.1 | 24.2 |
|                                        | Rapeseed oil                                             | 28.0 | 35.2 | 16.7 | 25.4 | 44.9 | 13.3 | 26.0 | 37.3 | 41.5 | 28.8 | 33.8 | 46.0 | 27.9 | 35.1 |
|                                        | Palm oil                                                 |      |      |      |      |      |      |      | 26.2 | 17.7 | 33.8 | 23.6 | 3.2  | 40.8 | 25.8 |
|                                        | Hardened fish oil (IV = 65)                              | 38.3 | 25.8 | 49.5 | 34.5 | 4.6  | 59.7 | 37.7 |      |      |      |      |      |      |      |
|                                        | Hardened high-erucic rapeseed oil (IV = 10)              | 12.0 | 13.0 | 11.3 | 12.4 | 26.2 | 2.7  | 12.1 | 14.9 | 14.9 | 15.0 | 14.9 | 26.6 | 7.2  | 14.9 |
| Fatty acid composition (%)             | Saturated fatty acid content                             | 48.0 | 48.0 | 52.0 | 52.0 | 50.0 | 50.0 | 50.0 | 48.0 | 48.0 | 52.0 | 52.0 | 50.0 | 50.0 | 50.0 |
|                                        | Content of saturated fatty acid with 12 or fewer carbons | 12.5 | 15.0 | 13.0 | 16.0 | 14.0 | 14.0 | 14.0 | 12.5 | 15.0 | 13.0 | 16.0 | 14.0 | 14.0 | 14.0 |
|                                        | Content of saturated fatty acid with 20 or more carbons  | 8.0  | 8.0  | 8.0  | 8.0  | 14.0 | 4.0  | 8.0  | 8.0  | 8.0  | 8.0  | 8.0  | 14.0 | 4.0  | 8.0  |
|                                        | Trans-isomer content                                     | 17.0 | 11.9 | 21.7 | 15.5 | 4.0  | 25.3 | 16.8 | 1.2  | 1.2  | 1.2  | 1.2  | 2.1  | 0.6  | 1.2  |
| Reacted oil properties                 | Slip melting point (°C)                                  | 29.5 | 27.6 | 30.3 | 29.9 | 28.9 | 29.3 | 29.1 | 29.7 | 27.8 | 30.4 | 29.7 | 28.7 | 29.5 | 28.8 |
|                                        | Penetration determination temperature (°C)               | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   |
|                                        | Penetration value                                        | 127  | 112  | 93   | 90   | 105  | 100  | 98   | 130  | 110  | 90.0 | 92   | 103  | 102  | 100  |

It is clear from Table 1 that reacted oil with the same properties as hardened fish oil A are obtained in all of the examples.

(Examples 15 through 28)

A random interesterification reacted oil (total of 14 types, 7 types of oil composition BB and 7 types of oil composition BT) was made by random interesterification using an oil mixture with a total saturated fat content of 68 wt% to 75 wt%, a content of saturated fatty acid with 12 or fewer carbons of 11 wt% to 16 wt%, a content of saturated fatty acid with 20 or more carbons of 5 to 20 wt%, and a trans isomer content either exceeding 3 wt% or of 3 wt% or less.

The raw fat and oil mixture (mixture percentage in wt%) and fatty acid composition and properties of the random interesterification reacted oil are shown in Table 2.

Table 2.

|                                        | Example No.                                              | 15   | 16   | 17   | 18   | 19   | 20   | 21   | 22   | 23   | 24   | 25   | 26   | 27   | 28   |
|----------------------------------------|----------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                                        | Random interesterification reacted oil name              | BB-1 | BB-2 | BB-3 | BB-4 | BB-5 | BB-6 | BB-7 | BT-1 | BT-2 | BT-3 | BT-4 | BT-5 | BT-6 | BT-7 |
| Raw fat and oil mixture percentage (%) | Coconut oil                                              | 19.0 | 24.2 | 22.4 | 27.6 | 24.2 | 24.1 | 24.2 | 18.8 | 24.1 | 22.3 | 27.6 | 24.2 | 24.0 | 24.1 |
|                                        | Rapeseed oil                                             |      |      |      |      |      |      |      |      | 27.5 |      |      | 26.1 |      |      |
|                                        | Palm oil                                                 |      |      |      |      |      |      |      | 57.2 |      | 39.4 | 39.6 |      | 47.4 | 49.7 |
|                                        | Hardened fish oil (IV = 74)                              | 29.6 | 29.8 | 19.6 | 19.8 | 25.6 | 25.4 | 25.4 |      |      |      |      |      |      |      |
|                                        | Hardened palm oil (IV = 10)                              | 32.6 | 27.2 | 39.1 | 33.7 | 11.8 | 41.4 | 31.5 | 6.9  | 31.5 | 21.2 | 15.7 | 15.3 | 20.3 | 9.1  |
|                                        | Hardened high-erucic rapeseed oil (IV = 10)              | 18.8 | 18.8 | 18.9 | 18.9 | 38.4 | 9.1  | 18.9 |      |      |      |      |      |      |      |
|                                        | Hardened high-erucic rapeseed oil (IV = 1)               |      |      |      |      |      |      |      | 17.1 | 16.9 | 17.1 | 17.1 | 34.4 | 8.3  | 17.1 |
| Fatty acid composition (%)             | Saturated fatty acid content                             | 68.0 | 68.0 | 75.0 | 75.0 | 71.0 | 71.0 | 71.0 | 68.0 | 68.0 | 75.0 | 75.0 | 71.0 | 71.0 | 71.0 |
|                                        | Content of saturated fatty acid with 12 or fewer carbons | 11.0 | 14.0 | 13.0 | 16.0 | 14.0 | 14.0 | 14.0 | 11.0 | 14.0 | 13.0 | 16.0 | 14.0 | 14.0 | 14.0 |
|                                        | Content of saturated fatty acid with 20 or more carbons  | 10.0 | 10.0 | 10.0 | 10.0 | 20.0 | 5.0  | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 20.0 | 5.0  | 10.0 |
|                                        | Trans-isomer content                                     | 16.2 | 15.9 | 12.7 | 12.3 | 14.5 | 14.5 | 14.4 | 0.7  | 2.7  | 1.9  | 1.4  | 1.6  | 1.7  | 0.9  |
| Reacted oil properties                 | slip melting point (°C)                                  | 37.7 | 38.4 | 39.4 | 38.8 | 38.0 | 38.5 | 38.3 | 37.8 | 38.6 | 39.3 | 38.7 | 38.5 | 38.7 | 38.4 |
|                                        | Penetration determination temperature (°C)               | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   | 20   |
|                                        | Penetration value                                        | 28   | 28   | 22   | 20   | 25   | 23   | 23   | 29   | 26   | 21   | 23   | 24   | 25   | 27   |

It is clear from Table 2 that reacted oil with the same properties as hardened fish oil B are obtained in any of the examples.

(Examples 29 through 42)

A random interesterification reacted oil (total of 14 types, 7 types of oil composition CC and 7 types of oil composition CT) was made by random interesterification using an oil mixture with a total saturated fat content of 79 wt% to 82 wt%, a content of saturated fatty acid with 12 or fewer carbons of 12 wt% to 17 wt%, a content of saturated fatty acid with 20 or more carbons of 8 wt% to 24 wt%, and a trans isomer content either exceeding 3 wt% or of 3 wt% or less.

The raw fat and oil mixture (mixture percentage in wt%) and fatty acid composition and properties of the random interesterification reacted oil are shown in Table 3.

Table 3.

|                                        | Example No.                                              | 29   | 30   | 31   | 32   | 33   | 34   | 35   | 36   | 37   | 38   | 39   | 40   | 41   | 42   |
|----------------------------------------|----------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                                        | Random interesterification reacted oil name              | CC-1 | CC-2 | CC-3 | CC-4 | CC-5 | CC-6 | CC-7 | CT-1 | CT-2 | CT-3 | CT-4 | CT-5 | CT-6 | CT-7 |
| Raw fat and oil mixture percentage (%) | Coconut oil                                              | 20.6 | 25.8 | 24.1 | 29.3 | 25.9 | 25.8 | 25.8 | 20.6 | 25.8 | 24.1 | 29.3 | 25.9 | 25.8 | 25.8 |
|                                        | Palm oil                                                 | 24.6 | 24.8 | 17.0 | 17.3 | 21.2 | 20.9 | 20.9 | 30.0 | 30.2 | 22.4 | 22.7 | 32.1 | 24.5 | 26.4 |
|                                        | Hardened palm oil (IV = 10)                              | 31.9 | 26.4 | 35.9 | 30.4 | 6.4  | 38.1 | 30.3 | 28.9 | 23.4 | 33.0 | 27.5 | 0.4  | 36.1 | 27.3 |
|                                        | Hardened high-erucic rapeseed oil (IV = 10)              | 22.9 | 23.0 | 23.0 | 23.0 | 46.5 | 15.2 | 23.0 |      |      |      |      |      |      |      |
|                                        | Hardened high-erucic rapeseed oil (IV = 1)               |      |      |      |      |      |      |      | 20.5 | 20.6 | 20.5 | 20.5 | 41.6 | 13.6 | 20.5 |
| Fatty acid composition (%)             | Saturated fatty acid content                             | 79.0 | 79.0 | 82.0 | 82.0 | 80.5 | 80.5 | 80.5 | 79.0 | 79.0 | 82.0 | 82.0 | 80.5 | 80.5 | 80.5 |
|                                        | Content of saturated fatty acid with 12 or fewer carbons | 12.0 | 15.0 | 14.0 | 17.0 | 15.0 | 15.0 | 15.0 | 12.0 | 15.0 | 14.0 | 17.0 | 15.0 | 15.0 | 15.0 |
|                                        | Content of saturated fatty acid with 20 or more carbons  | 12.0 | 12.0 | 12.0 | 12.0 | 24.0 | 8.0  | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 24.0 | 8.0  | 12.0 |
|                                        | Trans-isomer content                                     | 4.4  | 4.0  | 4.7  | 4.3  | 4.2  | 4.3  | 4.3  | 2.5  | 2.1  | 2.8  | 2.4  | 0.4  | 3.0  | 2.4  |
| Reacted oil properties                 | Slip melting point (°C)                                  | 42.5 | 42.0 | 44.2 | 43.5 | 42.2 | 42.5 | 42.3 | 43.2 | 41.8 | 44.3 | 43.0 | 42.5 | 42.9 | 43.0 |
|                                        | Penetration determination temperature (°C)               | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   |
|                                        | Penetration value                                        | 32   | 25   | 26   | 23   | 26   | 25   | 24   | 30   | 26   | 25   | 26   | 24   | 26   | 25   |

It is clear from Table 3 that reacted oil with the same properties as hardened fish oil C are obtained in any of the examples.

(Comparative Examples 1 through 12)

Random interesterification reacted oil (a total of 12 types, 4 types of oil composition AAA, 4 types of oil composition BBB, and 4 types of oil composition CCC) were made by random interesterification as in Example 1 using fat and oil mixtures that little by little exceeded the range of the fatty acid compositions of the present invention.

The raw fat and oil mixture (mixture percentage in wt%) and fatty acid composition and properties of the random interesterification reacted oil are shown in Table 4.

Table 4.

|                                                 | Comparative example No.                                        | 1         | 2         | 3         | 4         | 5         | 6         | 7         | 8         | 9         | 10        | 11        | 12        | 13        | 14        | 15        |
|-------------------------------------------------|----------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                                 | Random<br>interesterification<br>reacted oil name              | AAA-<br>1 | AAA-<br>2 | AAA-<br>3 | AAA-<br>4 | BBB-<br>1 | BBB-<br>2 | BBB-<br>3 | BBB-<br>4 | CCC-<br>1 | CCC-<br>2 | CCC-<br>3 | CCC-<br>4 | AAA-<br>5 | BBB-<br>5 | CCC-<br>5 |
| Raw fat and oil<br>mixture<br>percentage<br>(%) | Coconut oil                                                    | 20.8      | 28.6      | 20.8      | 28.6      | 18.1      | 28.5      | 18.0      | 28.5      | 19.7      | 30.2      | 19.7      | 30.2      | 24.1      | 24.1      | 25.8      |
|                                                 | Rapeseed oil                                                   | 28.1      | 41.2      | 12.2      | 25.2      |           |           |           |           |           |           |           |           | 21.2      | 21.6      | 9.9       |
|                                                 | Palm oil                                                       |           |           |           |           |           |           |           |           | 25.8      | 26.3      | 15.5      | 16.0      | 54.7      |           |           |
|                                                 | Hardened rapeseed oil<br>(IV = 74)                             |           |           |           |           | 30.3      | 30.6      | 18.8      | 19.0      |           |           |           |           |           |           |           |
|                                                 | Hardened fish oil<br>(IV = 65)                                 | 39.1      | 16.6      | 56.2      | 33.8      |           |           |           |           |           |           |           |           |           |           |           |
|                                                 | Hardened palm oil<br>(IV = 10)                                 |           |           |           |           | 32.8      | 22.0      | 44.3      | 33.6      | 31.5      | 20.5      | 41.8      | 30.8      |           | 54.3      | 64.3      |
|                                                 | Hardened high-erucic<br>rapeseed oil (IV = 10)                 | 12.0      | 13.6      | 10.8      | 12.4      | 18.8      | 18.9      | 18.9      | 18.9      | 23.0      | 23.0      | 23.0      | 23.0      |           |           |           |
| Fatty acid<br>composition<br>(%)                | Saturated fatty acid<br>content                                | 47.5      | 47.5      | 52.5      | 52.5      | 67.5      | 67.5      | 75.5      | 75.5      | 78.5      | 78.5      | 82.5      | 82.5      | 50.0      | 71.0      | 80.5      |
|                                                 | Content of saturated<br>fatty acid with 12 or<br>fewer carbons | 12.0      | 16.5      | 12.0      | 16.5      | 10.5      | 16.5      | 10.5      | 16.5      | 11.5      | 17.5      | 11.5      | 17.5      | 14.0      | 14.0      | 15.0      |
|                                                 | Content of saturated<br>fatty acid with 20 or<br>more carbons  | 8.0       | 8.0       | 8.0       | 8.0       | 10.0      | 10.0      | 10.0      | 10.0      | 12.0      | 12.0      | 12.0      | 12.0      | 0.0       | 0.0       | 0.0       |
|                                                 | Trans-isomer content                                           | 1.0       | 1.1       | 0.9       | 1.0       | 4.1       | 3.3       | 5.1       | 4.2       | 4.4       | 3.5       | 5.2       | 4.3       | 0.0       | 4.3       | 5.1       |
| Reacted oil<br>properties                       | Slip melting point (°C)                                        | 29.0      | 26.3      | 31.9      | 30.1      | 38.5      | 36.2      | 41.9      | 39.4      | 42.8      | 40.0      | 44.8      | 42.5      | 28.4      | 38.7      | 42.9      |
|                                                 | Penetration<br>determination<br>temperature (°C)               | 20        | 20        | 20        | 20        | 20        | 20        | 20        | 20        | 30        | 30        | 30        | 30        | 20        | 20        | 30        |
|                                                 | Penetration value                                              | 138       | 128       | 80        | 84        | 35        | 37        | 29        | 18        | 36        | 28        | 25        | 16        | 100       | 23        | 26        |

It is clear from Table 4 that reacted oil with the same properties as the fat and oil compositions of the present invention are not are obtained in any of the comparative examples.

(Comparative Examples 13 through 15)

A fat and oil mixture whose saturated fatty acid content and content of saturated fatty acid with 12 or fewer carbons were within the range of the present invention was prepared as in Example 1 using fat and oil comprising almost no fatty acid with 20 or more carbons and a random interesterification reacted oil (a total of 3 types, 1 of fat and oil composition AAA, 1 of fat and oil composition BBB and 1 of fat and oil composition CCC) was made by random interesterification of this fat and oil mixture. The results are shown in Table 4.

It is clear from Table 4, that reacted oil with properties corresponding to hardened fish oil A, hardened fish oil B and hardened fish oil C is obtained, even when fat and oil mixtures containing almost no fatty acid with 20 or more carbons is used, in comparative examples 13, 14, and 15. (Examples 43 through 57, comparative examples 16 through 18, control examples 1 through 3)

Margarine was made using the fat and oil compositions with properties corresponding to hardened fish oil A, hardened fish oil B, or hardened fish oil C, etc., obtained as previously described and properties were evaluated.

#### Method and conditions for making margarine

1) Preparation of oil phase part: 80.94 parts by weight raw mixed fat and oil (referred to as "mixed oil" below), 0.1 part by weight Emulji MS (Riken Vitamin) and 0.1 part by weight soybean lecithin as emulsifier, 10 ppm carotene and 0.01 part by weight anato coloring as coloration agents, and 5 ppm butter flavor and 70 ppm milk flavor were mixed as flavorings and kept at 60°C.

2) Preparation of aqueous phase part: 14.4 parts by weight nonfat milk (milk solid content of 8%) and 1.2 parts by weight table salt were mixed and then water was added to bring the water content to 16.4 parts by weight. The mixture was pasteurized for 30 minutes at 80°C or higher.

3) Pre-emulsification and plasticization by rapidly cooling: The oil phase part and aqueous phase part prepared in above-mentioned 1) and 2) were mixed and kept at 60°C while being emulsified and homogenized by being continuously passed through an emulsification tower. The product was quenched and plasticized with a combinator-type model machine consisting of 3 steps of cooling cylinders.

Plasticization by rapidly cooling was performed by adjusting the amount of cooling medium flowing in order to bring the step 2 outlet temperature to a temperature that was  $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$  lower than the slip melting temperature of the mixed oil, or in order to bring the step 3 outlet temperature

to a temperature that was  $13^{\circ}\text{C} \pm 2^{\circ}\text{C}$  lower than the slip melting point of the mixed oil, or in order to bring the step 1 outlet temperature to approximately the average of the step 2 outlet temperature and the step 1 inlet temperature.

The cooling cylinders turned at 500 rpm in steps 1, 2 and 3, and as a rule, the quantity of flow was 50 Kg/Hr.

4) Packing: the product that had been rapidly cooled and plasticized was packed in a 5 Kg corrugated cardboard box.

5) Tempering: The product packed in the corrugated cardboard box was matured by being stored for 36 hours at a temperature that was  $5^{\circ}\text{C} \pm 1^{\circ}\text{C}$  lower than the slip melting point of the mixed oil.

6) Storage conditions: After tempering, the margarine was stored at a temperature that was  $15^{\circ}\text{C}$  to  $20^{\circ}\text{C}$  lower than the slip melting point of the mixed oil.

Margarine product evaluation items, methods and conditions

1) Penetration value: Sample was collected with a penetration can (diameter of 57 mm, length of 40 mm) cut at both ends completely thrust from one end into margarine packed in a corrugated cardboard box and bulging at both ends. The two ends of the of the penetration can were cut with a butter knife and immersed in a thermostatic water bath

at the determination temperature. The penetration value was determined with a penetrometer 2 hour later.

2) Texture and gloss: The surface of the margarine packed in the corrugated cardboard box was smoothly shaved off with a butter knife and the surface state of the margarine was evaluated by the 5-point method in both cases.

3) Texture evaluation criteria:

5 points: very smooth, no grainy feeling whatsoever.

4 points: smooth, almost no grainy feeling.

3 points: somewhat smooth, but has a grainy feeling.

2 points: not very smooth and has a very grainy feeling.

1 point: not smooth at all, grainy.

4) Gloss evaluation criteria:

5 points: very lustrous.

4 points: quite lustrous.

3 points: lustrous.

2 points: not very lustrous.

1 point: not lustrous at all.

Butter cream tests

The tests were performed in a thermostatic chamber set at the determination temperature using a Hobart mixeer (Kantomixer Co., Ltd.) Type N50 (for 5 coats). The tests were performed twice, immediately after and 4 weeks after tempering was completed.

Three hundred grams margarine sample that has been kept at the determination temperature were introduced to a bowl and set on the Hobart mixer and mixed for 2 minutes at agitation speed No. 1 (low speed) to soften the sample. Then 240 ml syrup that had been brought to specific gravity of 1.31 were added over a 1-minute period while mixing. Next, the mixing speed was brought to No. 2 (medium speed) and mixing was stopped after 5 minutes. Sample that had stuck to the inside walls of the bowl were scraped off and the margarine was further mixed. Mixing was stopped and the cream was placed on a scale pan and weighed to find the creaming value (air content ml/ sample g x 100).

The creaming value was determined with an essential mixing time after bringing mixing speed to No. 2 (medium speed) of 10 minutes and 15 minutes. The cream after this procedure was evaluated for the following items.

#### Cream evaluation items

1) Syrup separation: the extent of syrup separation was evaluated based on the following evaluation criteria:

5 points: no separation of syrup, uniform gloss.

4 points: no separation of syrup, but gloss was somewhat nonuniform.

3 points: separation of small grains of syrup.

2 points. considerable separation of small grains of syrup.

1 point: separation of large grains of syrup.

2) Stiffness, or evaluation of decorating performance: Cream was placed in a decorating bag with a flower tip attached and stiffness when it was squeezed out was evaluated.

5 points: adequate stiffness, easily squeezed.

4 points: some problem with stiffness, but easy to squeeze.

3 points: somewhat too stiff or too soft, but easy to squeeze.

2 points: somewhat stiff or somewhat stiff, somewhat difficult to squeeze.

1 point: too stiff or too soft, difficult to squeeze.

3) Texture and gloss: The surface state of cream that had been squeezed from the decorating bag with a flower tip was evaluated.

The evaluation criteria were the same as in "Margarine product evaluation items, methods and conditions."

4) Spreadability: surface state of the squeezed cream was evaluated.

5 points = the squeezed texture (edge) was sharp and the texture was clean.

4 points: the squeezed texture (edge) was sharp, but it was somewhat messy.

3 points = the squeezed texture (edge) was broken off in places and there were pits here and there.

2 points: the squeezed texture (edge) was broken off in many places and there were many pits.

1 point: the squeezed edge was uneven and extremely brittle.

5) Firmness: Vibrations were applied to the squeezed cream and shape retention after vibrating was evaluated.

5 points: there was no change in shape from before vibrating. The cream was very stable.

4 points: there was very little change in shape, but the cream was stable.

3 points: shape changed only slightly.

2 points: shape changed.

1 point: there was a large change in shape.

Preparation and evaluation of margarine

Margarines with different slip melting points and hardness were made and evaluated.

Control examples 1 through 3 used fat and oil that was mainly fat and oil selected from hardened fish oil A, hardened fish oil B, and hardened fish oil C.

Comparative examples 16 through 18 used 1 or 2 or more selected from hardened fish oil A, hardened fish oil B and hardened fish oil C and fat and oil compositions obtained in comparative examples 13, 14, and 15.

Examples 43 through 57 used 1 or 2 or more selected from hardened fish oil A, hardened fish oil B and hardened fish oil C and fat and oil compositions obtained in Examples 1 through 42.

Furthermore, the properties of the hardened fish oils used here are listed below:

Hardened fish oil A: slip melting point of 29.8°C, penetration value at 20°C of 105

Hardened fish oil B: slip melting point of 38.4°C, penetration value at 20°C of 24.

Hardened fish oil C: slip melting point of 43.5°C, penetration value at 30°C of 27.

The raw oil mixture of the mixed oil (mixture percentage is in wt%) and slip melting point of the mixed oil are shown in Tables 5 through 7.

Table 5.

|                                  |                            | Control example 1 | Comparative example 16 | Example 43 | Example 44 | Example 45 |
|----------------------------------|----------------------------|-------------------|------------------------|------------|------------|------------|
| Mixed oil mixture percentage (%) | Hardened fish oil A        | 80                | 40                     | 40         | 40         |            |
|                                  | Hardened fish oil B        |                   |                        |            |            |            |
|                                  | Hardened fish oil C        |                   |                        |            |            |            |
|                                  | Rapeseed oil               | 20                | 20                     | 20         | 20         | 20         |
|                                  | Comparative Example 13     |                   | 40                     |            |            |            |
|                                  | Fat and oil composition AA |                   |                        | AA-1 20    |            | AA-2 20    |
|                                  |                            |                   |                        | AA-4 20    |            | AA-3 20    |
|                                  | Fat and oil composition AT |                   |                        |            | AT-1 20    | AT-2 20    |
|                                  |                            |                   |                        |            | AT-4 20    | AT-3 20    |
| Slip melting point ( °C)         |                            | 27.8              | 28.0                   | 28.5       | 28.2       | 27.8       |

Table 6

|                                           |                            | Control<br>Example 2 | Comparative<br>Example 17 | Example 46 | Example 47 | Example 48 | Example 49 | Example 50 |
|-------------------------------------------|----------------------------|----------------------|---------------------------|------------|------------|------------|------------|------------|
| Mixed oil<br>mixture<br>percentage<br>(%) | Hardened fish oil A        | 80                   | 60                        | 60         | 60         | 20         | 20         |            |
|                                           | Hardened fish oil B        | 20                   |                           |            |            |            |            |            |
|                                           | Hardened fish oil C        |                      |                           |            |            |            |            |            |
|                                           | Comparative Example 13     |                      | 20                        |            |            |            |            |            |
|                                           | Comparative example 14     |                      | 20                        |            |            |            |            |            |
|                                           | Fat and oil composition AA |                      |                           | AA-5    20 |            | AA-6    60 |            | AA-7    40 |
|                                           | Fat and oil composition AT |                      |                           |            | AT-5    20 |            | AT-6    60 | AT-7    40 |
|                                           | Fat and oil composition BB |                      |                           | BB-1    10 |            | BB-2    10 |            | BB-5    10 |
|                                           |                            |                      |                           | BB-4    10 |            | BB-3    10 |            |            |
|                                           | Fat and oil composition BT |                      |                           |            | BT-1    10 |            | BT-2    10 | BT-5    10 |
|                                           |                            |                      |                           |            | BT-4    10 |            | BT-3    10 |            |
| Slip melting point ( °C)                  |                            | 31.3                 | 31.6                      | 31.3       | 31.8       | 31.5       | 31.8       | 31.2       |

Table 7.

|                                           |                            | Control<br>Example 3 | Comparat<br>ive<br>Example<br>18 | Example<br>51 | Example<br>52 | Example<br>53 | Example<br>54 | Example<br>55 | Example<br>56 | Example<br>57 |
|-------------------------------------------|----------------------------|----------------------|----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Mixed oil<br>mixture<br>percentage<br>(%) | Hardened fish oil A        | 40                   | 40                               | 40            | 40            | 20            | 20            |               |               |               |
|                                           | Hardened fish oil B        | 40                   | 20                               | 20            | 20            | 20            | 20            |               |               |               |
|                                           | Hardened fish oil C        | 20                   |                                  |               |               |               |               |               |               |               |
|                                           | Comparative Example 14     |                      | 20                               |               |               |               |               |               |               |               |
|                                           | Comparative example 15     |                      | 20                               |               |               |               |               |               |               |               |
|                                           | Fat and oil composition AA |                      |                                  |               |               | AA-5<br>10    | AA-5<br>10    | AA-5<br>20    | AA-6<br>20    | AA-7<br>20    |
|                                           | Fat and oil composition AT |                      |                                  |               |               | AT-5<br>10    | AT-5<br>10    | AT-5<br>20    | AT-6<br>20    | AT-7<br>20    |
|                                           | Fat and oil composition BB |                      |                                  | BB-5<br>10    | BB-5<br>10    | BB-5<br>10    | BB-5<br>10    | BB-5<br>20    | BB-6<br>20    | BB-7<br>20    |
|                                           | Fat and oil composition BT |                      |                                  | BT-5<br>10    | BT-5<br>10    | BT-5<br>10    | BT-5<br>10    | BT-5<br>20    | BT-6<br>20    | BT-7<br>20    |
|                                           | Fat and oil composition CC |                      |                                  | CC-1<br>10    |               | CC-2<br>10    |               | CC-5<br>10    | CC-6<br>10    | CC-7<br>10    |
|                                           |                            |                      |                                  | CC-4<br>10    |               | CC-3<br>10    |               |               |               |               |
|                                           | Fat and oil composition CT |                      |                                  |               | CT-1<br>10    |               | CT-2<br>10    | CT-5<br>10    | CT-6<br>10    | CT-7<br>10    |
|                                           |                            |                      |                                  |               | CT-4<br>10    |               | CT-3<br>10    |               |               |               |
| Slip melting point (°C)                   |                            | 37.2                 | 36.8                             | 36.5          | 36.8          | 36.2          | 36.6          | 35.9          | 36.3          | 36.4          |

Changes over time in the properties of the margarine product are shown in Tables 8 through 10.

Table 8.

|                               |         | Control example 1 | Comparative example 16 | Example 43 | Example 44 | Example 45 |
|-------------------------------|---------|-------------------|------------------------|------------|------------|------------|
| 10 °C<br>penetration<br>value | 1 Day   | 130               | 131                    | 136        | 133        | 136        |
|                               | 1 Week  | 135               | 133                    | 127        | 136        | 128        |
|                               | 2 Weeks | 130               | 133                    | 128        | 130        | 124        |
|                               | 3 Weeks | 128               | 125                    | 125        | 128        | 128        |
|                               | 4 Weeks | 129               | 123                    | 120        | 130        | 120        |
|                               | 8 Weeks | 125               | 120                    | 120        | 128        | 122        |
| 15°C<br>penetration<br>value  | 1 Day   | 173               | 175                    | 181        | 177        | 175        |
|                               | 1 Week  | 175               | 170                    | 183        | 177        | 172        |
|                               | 2 Weeks | 170               | 176                    | 180        | 174        | 168        |
|                               | 3 Weeks | 170               | 168                    | 182        | 170        | 170        |
|                               | 4 Weeks | 175               | 165                    | 178        | 173        | 165        |
|                               | 8 Weeks | 168               | 165                    | 175        | 171        | 168        |
| Texture                       | 1 Day   | 5                 | 5                      | 5          | 5          | 5          |
|                               | 1 Week  | 5                 | 4                      | 5          | 5          | 5          |
|                               | 2 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 3 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 4 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 8 Weeks | 4                 | 2                      | 4          | 4          | 4          |
| Gloss                         | 1 Day   | 5                 | 4                      | 5          | 5          | 5          |
|                               | 1 Week  | 5                 | 4                      | 5          | 5          | 5          |
|                               | 2 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 3 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 4 Weeks | 5                 | 3                      | 5          | 5          | 5          |
|                               | 8 Weeks | 4                 | 2                      | 4          | 4          | 4          |

Table 9.

|                              |         | Control<br>example 2 | Comparative<br>example 17 | Example 46 | Example 47 | Example 48 | Example 49 | Example 50 |
|------------------------------|---------|----------------------|---------------------------|------------|------------|------------|------------|------------|
| 20°C<br>penetration<br>value | 1 Day   | 130                  | 131                       | 136        | 130        | 133        | 125        | 128        |
|                              | 1 Week  | 131                  | 135                       | 127        | 128        | 128        | 125        | 125        |
|                              | 2 Weeks | 130                  | 132                       | 130        | 130        | 125        | 120        | 128        |
|                              | 3 Weeks | 125                  | 130                       | 132        | 125        | 125        | 122        | 122        |
|                              | 4 Weeks | 128                  | 130                       | 128        | 125        | 122        | 120        | 118        |
|                              | 8 Weeks | 125                  | 128                       | 130        | 122        | 123        | 120        | 121        |
| 25°C<br>penetration<br>value | 1 Day   | 160                  | 165                       | 176        | 165        | 166        | 157        | 160        |
|                              | 1 Week  | 163                  | 168                       | 174        | 163        | 160        | 160        | 158        |
|                              | 2 Weeks | 162                  | 160                       | 176        | 160        | 162        | 154        | 155        |
|                              | 3 Weeks | 165                  | 162                       | 175        | 158        | 158        | 152        | 160        |
|                              | 4 Weeks | 161                  | 160                       | 171        | 160        | 160        | 154        | 155        |
|                              | 8 Weeks | 160                  | 160                       | 170        | 162        | 158        | 151        | 155        |
| Texture                      | 1 Day   | 5                    | 5                         | 5          | 5          | 5          | 5          | 5          |
|                              | 1 Week  | 5                    | 4                         | 5          | 5          | 5          | 5          | 5          |
|                              | 2 Weeks | 5                    | 4                         | 5          | 5          | 5          | 5          | 5          |
|                              | 3 Weeks | 5                    | 3                         | 5          | 5          | 5          | 5          | 5          |
|                              | 4 Weeks | 4                    | 3                         | 4          | 4          | 4          | 4          | 4          |
|                              | 8 Weeks | 4                    | 2                         | 4          | 4          | 4          | 4          | 4          |
| Gloss                        | 1 Day   | 5                    | 5                         | 5          | 5          | 5          | 5          | 5          |
|                              | 1 Week  | 5                    | 4                         | 5          | 5          | 5          | 4          | 5          |
|                              | 2 Weeks | 5                    | 3                         | 5          | 5          | 5          | 5          | 5          |
|                              | 3 Weeks | 5                    | 3                         | 5          | 5          | 5          | 5          | 5          |
|                              | 4 Weeks | 4                    | 3                         | 4          | 4          | 4          | 4          | 4          |
|                              | 8 Weeks | 4                    | 3                         | 4          | 4          | 4          | 4          | 4          |

Table 10.

|                              |         | Control<br>example 3 | Comparativ<br>e example<br>18 | Example 51 | Example 52 | Example 53 | Example 54 | Example 55 | Example 56 | Example 57 |
|------------------------------|---------|----------------------|-------------------------------|------------|------------|------------|------------|------------|------------|------------|
| 25°C<br>penetration<br>value | 1 Day   | 117                  | 115                           | 123        | 125        | 122        | 125        | 120        | 125        | 122        |
|                              | 1 Week  | 110                  | 115                           | 120        | 120        | 119        | 116        | 122        | 116        | 113        |
|                              | 2 Weeks | 115                  | 108                           | 121        | 123        | 115        | 118        | 117        | 117        | 119        |
|                              | 3 Weeks | 110                  | 105                           | 118        | 118        | 118        | 115        | 114        | 112        | 113        |
|                              | 4 Weeks | 105                  | 110                           | 115        | 118        | 114        | 110        | 111        | 110        | 110        |
|                              | 8 Weeks | 108                  | 103                           | 115        | 115        | 116        | 115        | 114        | 111        | 110        |
| 30°C<br>penetration<br>value | 1 Day   | 151                  | 148                           | 153        | 155        | 150        | 153        | 155        | 155        | 151        |
|                              | 1 Week  | 148                  | 150                           | 155        | 149        | 145        | 150        | 148        | 155        | 146        |
|                              | 2 Weeks | 150                  | 150                           | 152        | 152        | 147        | 150        | 148        | 150        | 146        |
|                              | 3 Weeks | 148                  | 145                           | 150        | 146        | 145        | 144        | 150        | 152        | 142        |
|                              | 4 Weeks | 139                  | 143                           | 148        | 148        | 142        | 147        | 144        | 148        | 143        |
|                              | 8 Weeks | 148                  | 140                           | 145        | 145        | 144        | 143        | 144        | 146        | 140        |
| Texture                      | 1 Day   | 5                    | 5                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 1 Week  | 5                    | 4                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 2 Weeks | 5                    | 4                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 3 Weeks | 4                    | 3                             | 5          | 4          | 4          | 5          | 5          | 4          | 4          |
|                              | 4 Weeks | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          | 4          | 4          |
|                              | 8 Weeks | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          | 4          | 4          |
| Gloss                        | 1 Day   | 5                    | 5                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 1 Week  | 5                    | 4                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 2 Weeks | 4                    | 3                             | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
|                              | 3 Weeks | 4                    | 3                             | 4          | 4          | 4          | 5          | 5          | 4          | 4          |
|                              | 4 Weeks | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          | 4          | 4          |
|                              | 8 Weeks | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          | 4          | 4          |

It is clear from Tables 8 through 10, that there is almost no difference in changes over time in the penetration value in any of the control examples, comparative examples, or examples.

That is, there were almost no changes in hardness of the product with time, whether a mixed oil of hardened fish oil A, hardened fish oil B or hardened fish oil C was used, a mixed oil of random interesterificated fat and oil containing almost no fatty acid with 20 or more carbons and hardened fish oil A, hardened fish oil B or hardened fish oil C was used, or mixed oil of the fat and oil composition of the present invention and hardened fish oil A, hardened fish oil B or hardened fish oil C was used.

It is clear from the changes over time in texture and gloss in Tables 8 through 10 that in contrast to the fact that all of control examples 1 through 3 had good quality after 8 weeks, comparative examples 16 through 18 were already lacking in quality after 2 weeks. Moreover, it is clear that all of examples 43 through 57 have the same good quality after 8 weeks as the control examples.

The cream evaluation results are shown in Tables 11 through 13.

Table 11.

|                  |                                     |            | Control Example<br>1 | Comparative<br>example 16 | Example 43 | Example 44 | Example 45 |
|------------------|-------------------------------------|------------|----------------------|---------------------------|------------|------------|------------|
| Whipping         | Room temperature<br>(°C)            |            | 14.1                 | 13.4                      | 13.5       | 13.8       | 13.5       |
|                  | Starting temperature<br>(°C)        |            | 14.0                 | 13.5                      | 13.5       | 13.4       | 13.6       |
|                  | Ending temperature<br>(°C)          |            | 15.1                 | 14.5                      | 14.5       | 14.6       | 14.8       |
|                  | Whipping time and<br>whipping value | Time       |                      |                           |            |            |            |
|                  |                                     | 10 Minutes | 190                  | 150                       | 182        | 185        | 190        |
|                  |                                     | 15 Minutes | 200                  | 183                       | 210        | 198        | 205        |
| Cream<br>texture | Separation                          |            | 5                    | 5                         | 5          | 5          | 5          |
|                  | Spreadability                       |            | 5                    | 5                         | 5          | 5          | 5          |
|                  | Firmness                            |            | 4                    | 3                         | 4          | 4          | 4          |
|                  | Texture                             |            | 4                    | 3                         | 4          | 4          | 4          |
|                  | Gloss                               |            | 4                    | 3                         | 4          | 4          | 4          |

Table 12.

|                  |                                     |            | Control<br>Example 2 | Comparativ<br>e example<br>17 | Example 46 | Example 47 | Example 48 | Example 49 | Example 50 |
|------------------|-------------------------------------|------------|----------------------|-------------------------------|------------|------------|------------|------------|------------|
| Whipping         | Room temperature<br>(°C)            |            | 22.1                 | 22.0                          | 22.2       | 22.1       | 22.1       | 22.3       | 22         |
|                  | Starting temperature<br>(°C)        |            | 21.5                 | 21.7                          | 21.8       | 21.5       | 21.7       | 21.4       | 21.6       |
|                  | Ending temperature<br>(°C)          |            | 22.2                 | 22.3                          | 22.5       | 22.5       | 22.7       | 22.8       | 22.4       |
|                  | Whipping time and<br>whipping value | Time       |                      |                               |            |            |            |            |            |
|                  |                                     | 10 Minutes | 180                  | 175                           | 190        | 185        | 180        | 175        | 176        |
|                  |                                     | 15 Minutes | 220                  | 205                           | 225        | 223        | 221        | 215        | 220        |
| Cream<br>texture | Separation                          |            | 5                    | 5                             | 5          | 5          | 5          | 5          | 5          |
|                  | Spreadability                       |            | 4                    | 4                             | 4          | 4          | 4          | 4          | 4          |
|                  | Firmness                            |            | 5                    | 4                             | 5          | 5          | 5          | 5          | 5          |
|                  | Texture                             |            | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          |
|                  | Gloss                               |            | 4                    | 3                             | 4          | 4          | 4          | 4          | 4          |

Table 13.

|                  |                                     |            | Control<br>Example<br>3 | Comparat<br>ive<br>example<br>18 | Example<br>51 | Example<br>52 | Example<br>53 | Example<br>54 | Example<br>55 | Example<br>56 | Example<br>57 |
|------------------|-------------------------------------|------------|-------------------------|----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Whipping         | Room temperature<br>(°C)            |            | 30.5                    | 31.2                             | 30.8          | 30.6          | 30.5          | 30.7          | 30.4          | 30.4          | 30.6          |
|                  | Starting temperature<br>(°C)        |            | 30.2                    | 31.0                             | 30.5          | 30.6          | 30.2          | 30.3          | 30.6          | 30.2          | 30.8          |
|                  | Ending temperature<br>(°C)          |            | 31.0                    | 31.5                             | 31.8          | 31.5          | 31.5          | 31.9          | 31.3          | 31.0          | 31.8          |
|                  | Whipping time and<br>whipping value | Time       |                         |                                  |               |               |               |               |               |               |               |
|                  |                                     | 10 Minutes | 172                     | 168                              | 175           | 170           | 175           | 180           | 175           | 168           | 174           |
|                  |                                     | 15 Minutes | 205                     | 190                              | 210           | 208           | 208           | 212           | 202           | 205           | 210           |
| Cream<br>texture | Separation                          |            | 5                       | 5                                | 5             | 5             | 5             | 5             | 5             | 5             | 5             |
|                  | Spreadability                       |            | 4                       | 3                                | 4             | 4             | 4             | 4             | 4             | 4             | 4             |
|                  | Firmness                            |            | 5                       | 4                                | 5             | 5             | 5             | 5             | 5             | 5             | 5             |
|                  | Texture                             |            | 5                       | 4                                | 5             | 5             | 5             | 5             | 5             | 5             | 5             |
|                  | Gloss                               |            | 4                       | 3                                | 4             | 4             | 4             | 4             | 4             | 4             | 4             |

Furthermore, the results of butter cream tests show the results when tempering was completed because there was almost no difference between when tempering was completed and 4 weeks later.

It is clear from Tables 11 through 13 that there was not a difference in the cream evaluation results between the control examples, comparative examples and examples in terms of the whipping value, separation of syrup and spreadability. The comparative examples clearly are inferior to the control examples in terms of firmness, texture and gloss. The examples were superior in quality rivaling the control examples in all cases.

The fat and oil composition of the present invention can provide products that have the same properties as products containing hardened fish oil in terms of changes over time in texture and gloss and whipping cream firmness, texture and gloss, even though it is used as a margarine or shortening raw material with hardened fish oil or without hardened fish oil. Moreover, margarine or shortening with the same properties as products obtained using hardened fish oil can be presented by the fat and oil composition of the present invention having a trans-isomer content of 3 wt% or less.



What Is Claimed Is :

1. A mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 48 wt% to 52 wt%, comprising:

12.5 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and

4 wt% to 14 wt% saturated fatty acid with 20 or more carbons,

wherein the slip melting point is  $29.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  is  $110 \pm 22$ .

2. A mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 68 wt% to 75 wt%, comprising:

11 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and

5 wt% to 20 wt% saturated fatty acid with 20 or more carbons,

wherein the slip melting point is  $38.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  is  $25 \pm 5$ .

3. A mixed random interesterificated fat and oil composition with a total saturated fatty acid content of 79 wt% to 82 wt%, comprising:

12 wt% to 17 wt% saturated fatty acid with 12 or fewer carbons and



8 wt% to 24 wt% saturated fatty acid with 20 or more carbons,

wherein the slip melting point is  $43.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $30^{\circ}\text{C}$  is  $25 \pm 7$ .

4. A fat and oil composition according to any of claims 1 through 3,

wherein the trans-isomer content as a constitutional fatty acid is 3 wt% or less.

5. A fat and oil composition, comprising:

at least two selected from the group consisting of the fat and oil compositions according to claims 1 through 4.

6. A fat and oil composition, comprising:

at least one selected from the group consisting of the fat and oil compositions according to claims 1 through 4 and

at least one other animal and vegetable fat and oil and animal and vegetable processed fat and oil.

7. A method of producing a fat and oil composition, comprising the step of:

random interesterification of a fat and oil mixture with a total saturated fatty acid content of 48 wt% to 52 wt% containing 12.5 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 4 wt% to 14 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $29.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  to  $110 \pm 22$ .



8. A method of producing a fat and oil composition, comprising the step of:

random interesterification of a fat and oil mixture with a total saturated fatty acid content of 68 wt% to 75 wt% containing 11 wt% to 16 wt% saturated fatty acid with 12 or fewer carbons and 5 wt% to 20 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $38.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $20^{\circ}\text{C}$  to  $25 \pm 5$ .

9. A method of producing a fat and oil composition, comprising the step of:

random interesterification of a fat and oil mixture with a total saturated fatty acid content of 79 wt% to 82 wt% containing 12 wt% to 17 wt% saturated fatty acid with 12 or fewer carbons and 8 wt% to 24 wt% saturated fatty acid with 20 or more carbons in order to bring the slip melting point to  $43.0 \pm 1.5^{\circ}\text{C}$  and the penetration value at  $30^{\circ}\text{C}$  to  $25 \pm 7$ .

10. A method of producing a fat and oil composition according to any of claims 7 through 9,

wherein a fat and oil mixture with a trans-isomer content as constitutional fatty acid of 3 wt% or less is used.