

FAT COMPOSITIONS

The present invention relates to an edible fat composition and food products for infant nutrition containing the fat composition.

5 Infant formulas contain one or more fats in association with other nutritional compounds such as protein, carbohydrate etc. Considerable research has been carried out over the years to improve the characteristics of infant formulas. Nevertheless there  
10 is still a need for improvements in the design of the fat to encourage maximum absorption thereof by the infant.

The extent of absorption is known to depend upon the chemical composition of the fatty acids. Thus  
15 studies by Holt et al., J. Pediat. 6, 427 (1935) established that the absorption is favoured by unsaturated fatty acids and fatty acids with relatively short carbon chains and is impaired by the presence of long chain saturated fatty acids. In practice stearic and palmitic  
20 acids are the least well absorbed acids. Thus U.S. 3,649,295 teaches at column 3, lines 17 to 21 that it is possible to estimate the percentage of fat absorption based upon the sum of the palmitic and stearic acids. In the present invention the sum of these two acids is  
25 18 to 24% by weight of the fatty acids of which palmitic acid constitutes 16% to 20% by weight of the fatty acids.

The positional distribution of palmitic acid in the triglycerides also influences the extent of absorption. In particular U.S. Patent 3,542,560  
30 demonstrated that palmitic acid was comparatively well absorbed from the  $\beta$ -position of the triglycerides but poorly absorbed from the  $\alpha$ - and  $\alpha'$ - positions. Thus this reference discourages the use of fats containing a low proportion of  $\beta$ - palmitic acid such as corn, soybean,  
35 palm, peanut, coconut, olive, babassu, cottonseed, oleo,

tallow and the like unless a fat having a relatively high proportion of  $\beta$ - palmitic acid such as lard is also used. However lard is unacceptable to many on religious grounds.

5 G.B. 2,067,587A teaches that oleic acid and palmitic acid are the predominating fatty acids in human milk fat. Oleic acid is the predominant unsaturated fatty acid. Palmitic acid is the predominant saturated fatty acid. The reference discloses fat compositions that are composed entirely of vegetable oils and provide  
10 triglycerides containing oleic, palmitic and linoleic acids in the same proportions as in human milk. The proportions in human milk fat are 28-46% (oleic acid), 18-28% (palmitic acid) and 6-16% (linoleic acid) by weight.

15 The reference discloses two examples where the palmitic acid content is up to 20% by weight. One blend consists of 40% babassu oil, 20% palm oil, 20% olive oil and 20% corn oil. The fatty acid pattern is said to be 33.4% oleic acid, 17.8% palmitic acid and 16.0% linoleic  
20 acid. The lauric acid content is not stated. However since lauric acid oils normally contain 45% or more of fatty acids as lauric acid, the lauric acid content can be presumed to be about 18%. The other blend consists of 45% palm kernel oil, 35% palm oil and 20% oleic oil.  
25 The fatty acid pattern is said to be 35.9% oleic acid, 24.0% palmitic acid and 6.4% linoleic acid. The lauric acid content is not stated but can be taken to be about 20%. Thus these two blends differ from the fatty acid pattern of human milk in their lauric acid content.

30 According to U.S. Patent No. 3,649,295 the lauric acid content of the fatty acids of human milk is 2.8% - 10.8%. Thus these two all vegetable oil blends have a fatty acid pattern with a large deviation (about 7% or 9%) from the lauric acid content in human milk.

35 The invention of U.S. Patent No. 3,649,295 is

directed to edible fat compositions consisting of 15-45% oleic oil, 10-45% oleo oil, 0-25% of one or more defined seed oils and 10-35% of coconut oil or babassu oil. Fat blends falling within the scope of U.S. Patent No.

5 3,649,295 have been used in commercial infant formulas. One such fat blend is designated as blend C below. As will be seen below, blend C is a very well absorbed fat composition.

10 Blend C has an advantage over the two all vegetable blends mentioned above in that its fatty acid pattern does not include such a large deviation of a major fatty acid from the range for that acid in human milk fat as that exhibited in respect of lauric acid in the two all vegetable blends. Thus in blend C the lauric acid  
15 content is 12.6% (1.8% deviation from the range of 2.8% - 10.8%), the palmitic acid content is 14.5% (about 3% deviation from the range of 18%-28%), the oleic acid content is 33.3% (within the human milk range) and the linoleic acid content is 16.5% (compared to the human  
20 range of 6-16%).

It has now been found that although blend C is a very well absorbed composition, the proportion of fat not absorbed can be reduced quite considerably without resorting to a very large deviation of a major fatty  
25 acid from the human milk range such as the deviation of 7% or 9% mentioned above.

The present invention provides a fat composition comprising (a) palm oil; (b) an oil selected from olive oil and oleic oil; (c) an oil selected from coconut oil, babassu oil and palm kernel oil; (d) an oil selected from  
30 soybean oil, corn oil, sunflower seed oil, cottonseed oil and safflower oil, and if desired, (e) up to 2% calculated on the weight of the fat composition of a lecithin such as soy lecithin; the amounts of the oils being such that the fat composition contains, per 100  
35 parts by weight of fatty acids, (i) 17 to 20, preferably

18 to 20, parts by weight of linoleic acid; (ii) 28 to 44, preferably 30 to 36, parts by weight of oleic acid; (iii) 15 to 22 parts by weight of the sum of lauric and myristic acids of which lauric acid constitutes no more than 15 parts by weight and (iv) 18 to 24 advantageously 18 to 22 parts by weight of the sum of palmitic and stearic acids of which palmitic acid constitutes 16 to 20 parts by weight.

In practice the total number of parts given under items (i) to (iv) will not total 100 parts because the fatty acid composition will include minor quantities of other fatty acids.

The preferred components of the fat composition of the invention are (a) palm oil, (b) oleic oil, (c) coconut oil and (d) soybean oil or corn oil and (e) soy lecithin. The amounts of the oils used are such as to provide the defined fatty acid profile.

The absorption characteristics of fat blends may be determined by the following procedure.

Young male Sprague-Dawley rats (Tekland) are fed a fat-free diet during a three day pretest period. The diet consists of (g/kg); vitamin-test casein, 220; cerelose, 719; mineral mix, 40; cellulose, 10; choline chloride, 1; and vitamin mix, 10. The rats are then divided by weight into groups of equal average weight (228g), 8 rats per group. Group A continues to receive the fat-free diet for the next six days. Each of the other groups are fed a diet containing a test fat blend for 3 days, and then fed the fat-free diet for the next 3 days. The test fat is added at a concentration of 15%, replacing an equal weight of cerelose in the fat-free composition.

Food consumption and body weight gain are recorded for the six day test period. Feces are collected daily from each individual rat and stored under alcohol until analysed for fat. Food and fecal fats are determined by the procedure of van de Kamer - a titration of the

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fatty acids of the saponified fat.

Two fat blends designated C and D were tested in the above procedure. Blend D is an example according to the present invention. As explained above, blend C is an embodiment of the invention of U.S. Patent No. 3,649,295.

TABLE I  
Composition of Blends (% by weight)

|    |                          | <u>C</u> | <u>D</u> |
|----|--------------------------|----------|----------|
| 10 | Palm Oil                 | 0        | 30       |
|    | Oleic Oil (oleinate 181) | 15       | 20       |
|    | Coconut Oil              | 27       | 27       |
|    | Soy Oil                  | 22       | 22       |
|    | Soy Lecithin Concentrate | 1        | 1        |
| 15 | Oleo Oil                 | 35       | 0        |

TABLE II  
Fatty Acid Composition of Blends (% by weight)

|    | Fat Blend | <u>C</u> | <u>D</u> |
|----|-----------|----------|----------|
|    | Caprylic  | 1.9      | 1.8      |
| 20 | Capric    | 1.4      | 1.4      |
|    | Lauric    | 12.6     | 12.7     |
|    | Myristic  | 6.2      | 5.7      |
|    | Palmitic  | 14.5     | 17.6     |
|    | Paloleic  | 2.1      | 0.6      |
| 25 | Stearic   | 7.9      | 4.1      |
|    | Oleic     | 33.3     | 33.9     |
|    | Linoleic  | 16.5     | 19.3     |
|    | Linolenic | 2.4      | 2.4      |

In addition other fatty acids are present in amounts below 0.5%. The composition is based upon GLC analysis.

TABLE III

RESULTS

|   | <u>Group</u> | <u>Weight Gain (g.)</u> | <u>% Absorption of Fat</u> |
|---|--------------|-------------------------|----------------------------|
|   | A (Fat free) | 15.3                    | -                          |
| 5 | C            | 16.5                    | 96.0                       |
|   | D            | 16.5                    | 97.7                       |

Both fat blends are absorbed remarkably well. However it will be observed that fat blend D had a higher percentage fat absorption than fat blend C.

10       The present invention also provides a food product adapted for human infant nutrition containing the fat composition according to the invention. Basically the food product comprises the fat composition, a protein source and a carbohydrate. The product may be a ready-  
15   to-feed liquid or in the form of a powder or concentrated liquid adapted to provide a ready-to-feed form by the addition of water and stirring. The product preferably contains 1 to 6g, advantageously about 3.6g of the fat composition of the invention, 1 to 2.5g, advantageously  
20   about 2.1g of protein and 2 to 15g, advantageously about 6 to 9g, of carbohydrate per 100 ml of the ready-to-feed liquid.

As proteins there may be mentioned casein, salts of casein (e.g. potassium caseinate) and lactalbumin. In  
25   particular cow's milk protein, whey protein or hydrolysed whey protein may be used. Cow's milk protein differs from that of human milk in the proportions present as casein and lactalbumin. Cow's milk has about 80% casein and 20% whey proteins whereas human milk has about 40% casein  
30   and about 60% whey proteins. Accordingly the protein used may be adapted to simulate that of human milk by supplementing cow's milk protein with an appropriate amount of whey protein. Because whey contains a very high proportion of the minerals of milk, the whey is subjected  
35   to demineralisation, in particular by electrodialysis

to prepare whey protein. Where a milk-free diet for infants who are intolerant of cow's milk protein is desired, the protein source may be isolated soy protein or hydrolysed casein.

5 As carbohydrate source lactose is generally preferred for most infants but may be undesirable in some cases, in particular in respect of infants suffering from lactose intolerance or cow's milk protein intolerance. Where a milk-free diet is desired,  
10 the carbohydrate source may be corn syrup solids or a combination of corn syrup solids with sucrose.

Additionally the infant formula would contain minerals to provide nutritionally acceptable quantities of calcium, phosphorus, potassium, sodium, chloride,  
15 magnesium, iron, copper, zinc and iodine and adequate quantities of the vitamins such as vitamin A, vitamin D, vitamin E, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin B<sub>3</sub>, vitamin B<sub>6</sub>, vitamin C, nicotinamide, folic acid, vitamin K<sub>1</sub>, biotin and choline.

20 The invention includes a process for the preparation of the fat composition by blending the components (a), (b), (c) and (d) and, if desired (e) together in such proportions that the resultant composition has the required composition of fatty acids. The proportions  
25 to be used can be calculated from the fatty acid profiles of the individual components. The blending is preferably performed at a blending temperature above the melting point of palm oil (circa. 35°C), whereby each component oil is in the liquid phase. The heating of the oils to  
30 the blending temperature and the mixing of the oils in a conventional mixing apparatus should be carried out with careful temperature control. A blending temperature within the range of about 36°C to 50°C may be used.

Alternatively the blending may be carried out by  
35 dissolving the solid component or components in at

5 To prepare the food product the fat composition is combined with the other components. Processing may be carried out in manner known per se. Oil-soluble vitamins are normally dissolved in the fat composition as a preliminary step.

### EXAMPLE 1

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### Composition of Blends (% by weight)

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### Fatty Acid Composition of Blends (% by weight)

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35 Values quoted for blends B and D are based upon

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GLC analysis. Those quoted for blends F and G represent calculated values based upon literature values for the individual oils.

EXAMPLE 2

5 Using fat blend D of Example 1, the following ready-to-feed infant formula is prepared, the amounts being set forth in 100 ml.

|    |                                           |          |
|----|-------------------------------------------|----------|
|    | Fat Blend D                               | 3.6g     |
|    | Soya Bean Protein Isolates                | 2.1g     |
| 10 | Corn Syrup Solids                         | 6.9g     |
|    | Calcium                                   | 63.0mg   |
|    | Phosphorus                                | 44.5mg   |
|    | Iron                                      | 0.67mg   |
|    | Zinc                                      | 0.37mg   |
| 15 | Copper                                    | 0.05mg   |
|    | Sodium                                    | 20.0mg   |
|    | Potassium                                 | 74.0mg   |
|    | Magnesium                                 | 6.9mg    |
|    | Chloride                                  | 37.0mg   |
| 20 | Iodine                                    | 0.01mg   |
|    | Manganese                                 | 0.11mg   |
|    | Vitamin A (retinol)                       | 265I.U.  |
|    | Vitamin D (cholecalciferol)               | 42.5I.U. |
|    | Vitamin E                                 | 0.95I.U. |
| 25 | Vitamin B <sub>1</sub> (thiamine)         | 0.08mg   |
|    | Vitamin B <sub>2</sub> (riboflavine)      | 0.11mg   |
|    | Vitamin B <sub>3</sub> (pantothenic acid) | 0.32mg   |
|    | Vitamin B <sub>6</sub> (pyridoxine)       | 0.05mg   |
|    | Vitamin B <sub>12</sub> (cyanocobalamin)  | 0.21µg   |
| 30 | Vitamin C (ascorbic acid)                 | 5.8mg    |
|    | Nicotinamide                              | 1.00mg   |
|    | Folic Acid                                | 5.3µg    |
|    | Vitamin K <sub>1</sub>                    | 10.5µg   |
|    | Biotin                                    | 3.70µg   |
|    | Choline                                   | 9.0mg    |
|    | Water                                     | 100ml    |

This formula is a nutritionally complete one particularly suitable for younger infants who receive the formula as the only source of food.

EXAMPLE 3

5 Older infants, from about four months of age onwards, may be fed with a formula that is not intended to supply the full nutritional needs of the infant as some nutrients will be provided by solid foods and other drinks. An example of such a formula in ready-to-feed  
10 form contains the following nutrients:-

|    | <u>Nutrient</u>                                          | <u>Per 100ml of Ready-to-Feed formula</u> | <u>Per 100g of Powder</u> |
|----|----------------------------------------------------------|-------------------------------------------|---------------------------|
|    | Protein g.<br>(from skimmed milk and demineralised whey) | 2.9                                       | 20                        |
| 15 | Fat Blend B g.                                           | 2.6                                       | 18                        |
|    | Carbohydrate g.<br>(Lactose and Corn Syrup Solids)       | 8.0                                       | 55                        |
| 20 | Calcium mg                                               | 115                                       | 800                       |
|    | Phosphorus mg                                            | 94                                        | 650                       |
|    | Iron mg                                                  | 0.8                                       | 5.5                       |
|    | Copper mg                                                | 0.058                                     | 0.4                       |
|    | Zinc mg                                                  | 0.43                                      | 3.0                       |
| 25 | Iodine mcg                                               | 6.9                                       | 55                        |
|    | Sodium mg                                                | 39.7                                      | 275                       |
|    | Magnesium mg                                             | 9.4                                       | 65                        |
|    | Potassium mg                                             | 105.4                                     | 730                       |
|    | Chloride mg                                              | 75.4                                      | 522                       |
| 30 | Manganese mcg                                            | 17                                        | 120                       |
|    | Vitamin A iu                                             | 299                                       | 2070                      |
|    | Vitamin E iu                                             | 1.08                                      | 7.42                      |
|    | Vitamin K <sub>1</sub> mcg                               | 6.6                                       | 45.6                      |
|    | Thiamine mg                                              | 0.081                                     | 0.56                      |
| 35 | Riboflavine mg                                           | 0.12                                      | 0.82                      |
|    | Vitamin B <sub>6</sub> mg                                | 0.048                                     | 0.33                      |

|   |                             |      |      |
|---|-----------------------------|------|------|
|   | Vitamin B <sub>12</sub> mcg | 0.12 | 0.82 |
|   | Vitamin C mg                | 6.6  | 45.6 |
|   | Niacin mg                   | 0.61 | 4.2  |
|   | Pantothenic acid mg         | 0.24 | 1.65 |
| 5 | Folic acid mcg              | 6.0  | 41.4 |
|   | Choline mg                  | 4.73 | 32.8 |
|   | Biotin mcg                  | 1.71 | 11.8 |
|   | Vitamin D iu                | 48   | 322  |

- 10      The fat blend mentioned in Example 1 is prepared by preheating the individual components to a temperature of about 40°C and thoroughly mixing the individual components at that temperature.



(9)

CLAIMS

1. A fat composition comprising
  - (a) palm oil;
  - (b) an oil selected from olive oil and oleic oil;
  - 5 (c) an oil selected from coconut oil, babassu oil and palm kernel oil;
  - (d) an oil selected from soybean oil, corn oil, sunflower seed oil, cottonseed oil and safflower oil and, if desired,
  - 10 (e) up to 2%, calculated on the weight of the fat composition, of a lecithin;

the amounts of the oils being such that the fat composition contains, per 100 parts by weight of fatty acids,

  - (i) 17 to 20 parts by weight of linoleic acid;
  - 15 (ii) 28 to 44 parts by weight of oleic acid;
  - (iii) 15 to 22 parts by weight of the sum of lauric and myristic acids of which lauric acid constitutes no more than 15 parts by weight; and
  - (iv) 18 to 24 parts by weight of the sum of palmitic  
20 and stearic acids of which palmitic acid constitutes 16 to 20 parts by weight.
2. A fat composition as claimed in Claim 1, which contains, per 100 parts by weight of fatty acids, 18 to 20 parts by weight on linoleic acid.
- 25 3. A fat composition as claimed in Claim 1 or 2, which contains, per 100 parts by weight of fatty acids, 30 to 36 parts by weight of oleic acid.
- 30 4. A fat composition as claimed in any one of Claims 1 to 3, which contains, per 100 parts by weight of fatty acids, 18 to 22 parts by weight of the sum of palmitic and stearic acids.
5. A fat composition as claimed in any one of



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Claims 1 to 4, wherein component (b) is oleic oil.

6. A fat composition as claimed in any one of Claims 1 to 5, wherein component (c) is coconut oil.

7. A fat composition as claimed in any one of Claims 1 to 6, wherein component (d) is soybean oil or corn oil.

8. A fat composition as claimed in any one of Claims 1 to 7, containing soy lecithin.

9. A fat composition substantially as described in Example 1 herein.

10. A food product adapted for human infant nutrition containing a fat composition as claimed in any one of Claims 1 to 9, a protein source and a carbohydrate.

11. A food product adapted for human infant nutrition substantially as described in Example 2 or 3 herein.

12. A process for the preparation of a fat composition as claimed in any one of Claims 1 to 9, which comprises blending the individual components at a temperature above the melting point of palm oil whereby each component oil is used in the liquid phase.

13. A process as claimed in Claim 12, wherein the blending temperature is within the range of about 36°C to 50°C.

14. A fat composition, whenever prepared by a process as claimed in Claim 12 or 13.

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15. A food product adapted for human infant nutrition comprising a fat composition as claimed in Claim 14, a protein source and a carbohydrate.

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