Bridging the Nutritional Gap: Omega-3 LC-PUFA Food Enrichment
Introduction

Fatty acids, or ‘fats’, are classified according to the degree of saturation:

- saturated fatty acids
- monounsaturated fatty acids
- polyunsaturated fatty acids (PUFAs)

PUFAs are further subdivided mainly into one of two families, omega-6 or omega-3.
Omega-6 PUFAs are predominantly obtained from vegetable oils, e.g. sunflower and corn oils.
Omega-3 PUFAs include alpha-linolenic acid (derived from green leaves and from some vegetable oils such as soybean oil), and eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA), present in the oils of fatty fish such as salmon, menhaden, mackerel, herring and tuna. Intakes of these fish are often low in Western diets. One possibility is to increase the intake of omega-3 PUFAs, especially EPA and DHA.
A balanced diet includes limited amounts of fats from various sources. The British Nutrition Foundation pointed out in their ‘Task Force Report’ that although people in Western societies eat too much ‘unhealthy’ fat, their intake of ‘healthy fats’, particularly of the omega-3 long-chain PUFAs (LC-PUFAs) EPA+DHA is low. Similar comments have been made by leading nutritionists in other countries. There is a nutritional ‘gap’ between the required intake and the average population intake.

The following recommendations, taken from the BNF Report, may serve as guidelines for dietary fat intake:

- **Reduce total fat intake**
  The total fat intake should be reduced to 30% or lower of total energy instead of the current level of nearly 40%.

- **Choose fats rich in polyunsaturated fatty acids**
  The intake of PUFAs should replace saturated fat intake to represent approximately 10% of total energy instead of the current average of 6%.

- **Select foods rich in EPA + DHA**
  Today, typical intakes of the long-chain omega-3 PUFAs EPA + DHA are below the desirable level of 0.5% of energy intake daily. Actual average intake is about 0.15 g/d.

### Range of nutritional gap omega-3 LC-PUFAs (EPA +DHA):
approx. 0.5-1.0 g/d

To close this ‘gap’ would require, for example, a daily intake of 2.0-4.0 g fish oil containing about 25% omega-3 LC-PUFAs as EPA and DHA.
How to Close the Gap

- **Eat more fatty fish**
The American Heart Association recently released their revised dietary guidelines and recommends at least 2 servings per week of fish (especially those rich in omega-3 LC-PUFAs) because of increased evidence for the cardiovascular benefits of fish.

- **Take fish oil capsules**
These can provide high daily dosages of omega-3 LC-PUFAs. Their use should be associated with a low-fat diet whenever possible.

- **Fortify existing products with ROPUFA®**
The substitution of fish oil high in omega-3 LC-PUFAs for other fats in foods can successfully bridge the nutritional gap and can now be accomplished without adversely affecting the flavour profile of the food.
Eating habits and total fat intakes remain unchanged, while the nutritional value of the food is increased.

**Food enrichment with ROPUFA® products represents a viable and effective way of closing the omega-3 LC-PUFAs nutritional gap**
How to Fulfil the Daily Recommended Intake

Generally, when fish oils are used in food, for example as a base for the production of margarine, they are in a ‘hardened’ or ‘hydrogenated’ form. In this form the biological activity of the long-chain omega-3 PUFAs is lost. It is now possible to incorporate non-hydrogenated omega-3 oil into a wide range of foods, in a form in which the nutritional value of the PUFAs is fully preserved.

The following pages outline some of the foods which have been successfully fortified in the Roche laboratories, showing how everyday food can be enriched with more than adequate amounts of omega-3 LC-PUFAs.

It is not necessary that the recommended daily intake of omega-3 LC-PUFAs is derived from a single serving of an individual product.

A variety of foods will help to ensure a balanced diet.

In the United States the FDA limits EPA+DHA intake per day to 3.0 grams from all sources (62 Federal Register at 30,753).

Note: A high intake of PUFAs increases the requirement for vitamin E in the body. An increased dietary intake of PUFAs requires higher intakes of vitamin E (minimum 1 mg per 1 g PUFAs).
A range of Roche products is available as oils, or, for applications where a dry form is required, in powder form. The powders are cold-water dispersible, and are produced using Roche micro-encapsulation technology.

The oils and powders recommended for food enrichment are particularly rich in omega-3 LC-PUFAs:

- ROPUFA® '30' n-3 Food Oil contains a minimum of 30% omega-3 PUFAs including 25% EPA + DPA + DHA
- ROPUFA® '10' n-3 Food Powder contains a minimum of 10% omega-3 PUFAs including 7% EPA + DPA + DHA

Alternative products for specific applications such as infant nutrition and enteral and parenteral nutrition are also available.
Food Applications

A wide range of foods can be enriched with ROPUFA® products. Roche application laboratories have successfully added ROPUFA® oils or powders to:

**Margarine and low-fat spread**
Typical daily serving: 30 g
Oil fortification level: 3%
Omega-3 LC-PUFA content: 225 mg/serving

![Margarine and bread image]

**Yoghurts**
Typical serving: 150 g
Oil fortification level: 0.6%
Omega-3 LC-PUFA content: 225 mg/serving

![Yoghurts image]
**UHT milk drinks**
Typical serving: 300 mL
Oil fortification level: 0.2%
Omega-3 LC-PUFA content: 150 mg/serving

**Orange-apricot beverages**
Typical serving: 300 mL
Oil fortification level: 0.10%
Omega-3 LC-PUFA content: 75 mg/serving

**Bread**
Typical serving: 100 g
Oil fortification level: 0.35%
Omega-3 LC-PUFA content: 90 mg/serving
PUFAs, unlike saturated and monounsaturated fatty acids, have two or more double bonds in their carbon chain which significantly influence their structural and physicochemical properties.

**Functions**

PUFA have several functions in human physiology.

- Structural constituents of cell membranes
- Precursors of eicosanoids, biologically active molecules that regulate essential body functions
- Structural constituents of the epidermis of the skin
- A source of energy

**Classification**

‘Omega-6’ or ‘n-6’ and ‘omega-3’ or ‘n-3’ designate two different classes of polyunsaturated fatty acids with differing physiological roles. These two families are usually represented in the human diet by linoleic acid (C18:2 n-6) and alpha-linolenic acid (C18:3 n-3).

Saturated: stearic acid

\[ \text{\begin{array}{c}
  \text{\includegraphics[width=0.5\textwidth]{stearic_acid}} \\
  \text{COOH}
\end{array}} \]

Monounsaturated: oleic acid

\[ \text{\begin{array}{c}
  \text{\includegraphics[width=0.5\textwidth]{oleic_acid}} \\
  \text{COOH}
\end{array}} \]

Polyunsaturated: linoleic acid (omega-6 family)

\[ \text{\begin{array}{c}
  \text{\includegraphics[width=0.5\textwidth]{linoleic_acid}} \\
  \text{COOH}
\end{array}} \]

Polyunsaturated: eicosapentaenoic acid (omega-3 family)

\[ \text{\begin{array}{c}
  \text{\includegraphics[width=0.5\textwidth]{eicosapentaenoic_acid}} \\
  \text{COOH}
\end{array}} \]

**Pathways leading to the creation of longer-chain PUFAs**

Our bodies need an adequate supply of linoleic and alpha-linolenic acid. From these two essential fatty acids, the longer-chain PUFAs and their derivatives can be formed via enzymatic transformations. These transformations can be limiting in certain conditions, and the longer-chain PUFAs then become conditionally essential.
In addition, only one set of enzymes is responsible for the metabolism of both omega-6 and omega-3 PUFAs. When an excess of one family of PUFAs is present in the diet, the metabolism of the other may be inhibited, leading to an imbalance in the production of the various prostaglandins, leukotrienes and thromboxanes.

**Metabolic ‘competition’ of omega-3 and omega-6 PUFAs**

<table>
<thead>
<tr>
<th>Omega-6</th>
<th>Enzyme</th>
<th>Omega-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linoleic C18:2</td>
<td>6-Desaturase</td>
<td>alpha-Linolenic C18:3</td>
</tr>
<tr>
<td>gamma-Linolenic C18:3</td>
<td></td>
<td>C18:4</td>
</tr>
<tr>
<td>Dihomo-gamma-Linolenic C20:3</td>
<td>Elongase</td>
<td>C20:4</td>
</tr>
<tr>
<td>Prostaglandins-Thromboxanes</td>
<td></td>
<td>Eicosapentaenoic C20:5</td>
</tr>
<tr>
<td>(1-series)</td>
<td></td>
<td>Prostaglandins-Thromboxanes</td>
</tr>
<tr>
<td>Arachidonic C20:4</td>
<td>5-Desaturase</td>
<td>(2-series)</td>
</tr>
<tr>
<td>Prostaglandins-Thromboxanes</td>
<td></td>
<td>Leukotrienes (4-series)</td>
</tr>
<tr>
<td>(2-series)</td>
<td></td>
<td>Prostaglandins-Thromboxanes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3-series)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leukotrienes (5-series)</td>
</tr>
<tr>
<td>Elongase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elongase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-Desaturase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-Oxidation</td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>

**Fatty-acid nomenclature:** for example, linoleic acid is specified as C18:2 n-6
- 18 → number of carbon atoms
- 2 → number of double bonds
- n-6 → position of the first double bond counting from the methyl end

**Desaturase:** introduction of an additional double bond
**Elongase:** elongation of the carbon chain by two units
Health Benefits

In recent years, a large number of studies have suggested the multiple benefits of dietary long-chain omega-3 PUFAs, particularly in maintaining cardiovascular health.

In the mid-1970s, Bang and Dyerberg reported a low mortality from cardiovascular disease among the Inuits of Greenland and among Danes whose diets are rich in omega-3 PUFAs from fish. These studies have suggested a beneficial effect of consuming fish rich in omega-3 fatty acids.

Since then, numerous studies have suggested that both EPA and DHA contribute to the heart healthy benefits of fish oil.

- EPA keeps blood vessel walls healthy by promoting vessel wall dilation while reducing development of blood clots by inhibiting platelet aggregation.
- Omega-3 LC-PUFAs may contribute to a more regular heartbeat.
- Both DHA and EPA lower blood triglycerides, a conditional risk factor for CVD.

American Heart Association

The American Heart Association Dietary Guidelines Revision 2000 includes increasing consumption of omega-3 fatty acids from food sources, including at least 2 servings of fish per week. Details for the guidelines are found at

http://circ.ahajournals.org/cgi/content/full/102/18/2284

U.S. Food and Drug Administration

Although the FDA standard for significant scientific agreement has not yet been reached for effects of omega-3 LC-PUFAs on heart health in the general population, a qualified health claim has been approved. Full text is available at

www.cfsan.fda.gov/~dms/supplmnt.html

International Society for the Study of Fatty Acids and Lipids

ISSFAL, a prominent world-wide organization of researchers, scientists and nutritionists supports increased consumption of omega-3 LC-PUFAs for heart-health benefits. For further information refer to

www.issfal.org/UK/heart_statement.htm
In 1989, Burr et al., asked some patients who suffered a previous heart attack to increase their consumption of fatty fish (a rich source of omega-3 LC-PUFAs). As shown below, people who increased their consumption of fatty fish had better prospects for survival compared to those who did not.
Fish Oil and Arrhythmia

The animal studies of Billman et al. (1994) suggested that omega-3 LC-PUFAs may reduce the risk of heart disease by promoting a regular heart beat.

GISSI Study

In 1999, the GISSI investigators reported that consuming 0.85 g EPA + DHA per day led to a 20% reduction in overall mortality and a 45% reduction in sudden death after 3.5 years among subjects who had had a previous heart attack.
Soft drink with 30% juice

Product information

ROPUFA Food Oil fortification level: 0.1%
Typical serving: 300 mL
Omega-3 LC-PUFA content: 75 mg/serving

Notes on ingredients

- Orange concentrate: 60 °Brix, 4.2% acidity
- Lemon concentrate: 45 °Brix, 32.7% acidity
- Stabilizer: guar gum
- beta-Carotene, ascorbic acid, citric acid from F. Hoffmann-La Roche Ltd

Ingredients

Juice compound (g)

<table>
<thead>
<tr>
<th>Part I</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>658.00</td>
<td></td>
</tr>
<tr>
<td>Lemon</td>
<td>95.96</td>
<td></td>
</tr>
<tr>
<td>Orange flavour</td>
<td>13.43</td>
<td></td>
</tr>
<tr>
<td>Apricot</td>
<td>6.71</td>
<td></td>
</tr>
<tr>
<td>Water</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>beta-Carotene</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>Water,</td>
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<table>
<thead>
<tr>
<th>Part III</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ascorbic acid</td>
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<tr>
<td>Citric acid</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>43.18</td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>Part IV</th>
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</thead>
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<tr>
<td>Stabilizer</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
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<td></td>
</tr>
<tr>
<td>Benzoate</td>
<td>65.80</td>
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<table>
<thead>
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<th>Part V</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>Orange oil</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>ROPUFA ‘30’</td>
<td>13.71</td>
<td></td>
</tr>
</tbody>
</table>

Bottling syrup

| Juice compound | 74.50               |
| Water          | 50.00               |
| Sugar syrup, 60 °Brix | 150.00 |

The bottling syrup is diluted with water to 1L ready-to-drink beverage

Preparation

Part I: The ingredients are mixed without incorporation of air.
Part II: The beta-carotene is dissolved in water.
Part III: The ascorbic acid and citric acid are dissolved in water.
Part IV: The sodium benzoate is dissolved in water. The stabilizer is added under stirring and hydrated for 1 h.
Part V: The ingredients are mixed.

All parts of the juice compound are mixed, and then homogenized using first a Turrax and then a high-pressure homogenizer (p₁ = 200 bar, p₂ = 50 bar). The final drink is prepared by dilution of the juice compound with sugar syrup and water.

Application information

1L of soft drink contains 300 mg ascorbic acid, 7 mg beta-carotene and 250 mg omega-3 LC-PUFAs

Instead of using sodium benzoate, the beverage may be pasteurized. The beverage may also be carbonated.

Shelf life: max. 3 months sealed in aluminium cans at 4 °C

We make no warranty as to results to be obtained in using any material and, since conditions of use are not under our control, we must necessarily disclaim all liability with respect to the use of any material supplied by Roche.
Soft drink with 90% juice

Product information

- ROPUFA Food Oil fortification level: 0.15%
- Typical serving: 300 mL
- Omega-3 LC-PUFA content: 110 mg/serving

Notes on ingredients

- Orange concentrate: 65 °Brix, 5.2% acidity
- Stabilizer: guar gum
- beta-Carotene, ascorbic acid and tocopheryl acetate from F. Hoffmann-La Roche Ltd

Ingredients

<table>
<thead>
<tr>
<th>Part I</th>
<th>Orange concentrate</th>
<th>598.30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apricot flavour, water soluble</td>
<td>2.01</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>158.73</td>
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<table>
<thead>
<tr>
<th>Part II</th>
<th>beta-Carotene 10% CWS</th>
<th>0.80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water, demineralized</td>
<td>66.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part III</th>
<th>Ascorbic acid</th>
<th>1.54</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water</td>
<td>66.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part IV</th>
<th>Stabilizer</th>
<th>1.34</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sodium benzoate</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>96.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part V</th>
<th>Orange flavour, oil soluble</th>
<th>0.22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Orange oil, distilled</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>5.80</td>
</tr>
<tr>
<td></td>
<td>Tocopheryl acetate</td>
<td>0.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drink</th>
<th>Juice compound</th>
<th>260.25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspartame</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Acesulfam K</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>739.12</td>
</tr>
</tbody>
</table>

Preparation

- Part I: The ingredients are mixed without incorporation of air.
- Part II: The beta-carotene is dissolved in demineralized water.
- Part III: The ascorbic acid is dissolved in water.
- Part IV: The sodium benzoate is dissolved in water. The stabilizer is added under stirring and hydrated for 1 h.
- Part V: The ingredients are mixed.

Application information

1L of soft drink contains 400 mg ascorbic acid, 20 mg beta-carotene, 45 mg tocopheryl acetate and 375 mg omega-3 LC-PUFAs

Instead of using sodium benzoate, the beverage may be pasteurized

Shelf life: max. 3 months sealed in aluminium cans at 4 °C

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Food Enrichment with ROPUFA®

Orange juice

**Product information**

- ROPUFA Food Oil fortification level: 0.1%
- Typical serving: 300 mL
- Omega-3 LC-PUFA content: 75 mg/serving

**Preparation**

**Part I**

The ingredients are mixed and homogenized in a high-pressure homogenizer (\(p_1 = 150\) bar, \(p_2 = 50\) bar) at 40 °C.

**Part II**

The ingredients are mixed. The mix is pre-heated by heat exchanger to 50 °C and homogenized in a high-pressure homogenizer (\(p_1 = 150\) bar, \(p_2 = 50\) bar), followed by thermal processing in a plate heat exchanger at 90 °C for 15 s, followed by cooling to 10 °C and aseptic filling.

**Ingredients**

<table>
<thead>
<tr>
<th>Part I (40 °Brix)</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>0.1</td>
</tr>
<tr>
<td>Orange juice concentrate, 66 °Brix</td>
<td>1.68</td>
</tr>
<tr>
<td>Water</td>
<td>0.99</td>
</tr>
<tr>
<td>Orange flavour, oil-soluble</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part II (11.2 °Brix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
</tr>
<tr>
<td>Orange juice concen.</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

**Application information**

Shelf life: approx. 6 months in Tetrapak at room temperature

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Instant fruit-flavored beverage mix

**Product information**

ROPUFA Food Powder fortification level:
in powder premix: 3.0%
in soft drink: 0.3%
Typical serving: 300 mL
Omega-3 LC-PUFA content: 80 mg/serving

**Preparation**

**Powder mix**
- Blend all dry ingredients together and sieve.

**Soft drink**
- Pour 29.6 g powder mix into 270.4 mL cold water.
- Stir until evenly dispersed.

**Application information**

100 g of instant soft drink powder contains 270 mg of omega-3 LC-PUFAs
Shelf life: max. 6 months in aluminium bags at room temperature

**Ingredients**

<table>
<thead>
<tr>
<th>Powder mix</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour</td>
<td>0.51</td>
</tr>
<tr>
<td>Masking flavour</td>
<td>0.12</td>
</tr>
<tr>
<td>Sugar</td>
<td>91.80</td>
</tr>
<tr>
<td>Citric acid</td>
<td>3.24</td>
</tr>
<tr>
<td>Tricalcium phosphate</td>
<td>0.51</td>
</tr>
<tr>
<td>Colour</td>
<td>0.24</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>0.30</td>
</tr>
<tr>
<td>Tocopheryl acetate</td>
<td>0.24</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Powder</td>
<td>3.04</td>
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<table>
<thead>
<tr>
<th>Soft drink</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Powder mix</td>
<td>29.60</td>
</tr>
<tr>
<td>Water</td>
<td>270.40</td>
</tr>
</tbody>
</table>

**Notes on ingredients**

- Citric acid, ascorbic acid, tocopheryl acetate from F. Hoffmann-La Roche Ltd
- Colour: elderberry concentrate

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Food Enrichment with ROPUFA®

Five-grain bread

**Product information**

ROPUFA Food Oil fortification level: 0.35%
ROPUFA Food Powder fortification level: 1.0%
Typical serving: 100 g
Omega-3 LC-PUFA content: 90 mg/serving

**Ingredients**

**Using ROPUFA ‘30’ n-3 Food Oil** (g)
- Five-grain flour: 100.00
- Water: 70.00
- Yeast: 4.00
- Salt: 2.00
- ROPUFA ‘30’ n-3 Food Oil: 0.56

**Using ROPUFA ‘10’ n-3 Food Powder**
- Five-grain flour: 100.00
- Water: 70.00
- Yeast: 4.00
- Salt: 2.00
- ROPUFA ‘10’ n-3 Food Powder: 1.60

**Notes on ingredients**
- Five-grain flour, e.g. wheat flour, spelt wheat, barley flakes, rye flakes, oat flakes, fibre

**Preparation**

The yeast is dissolved in part of the water. All ingredients, including the ROPUFA ‘10’ n-3 Food Powder or ROPUFA ‘30’ n-3 Food Oil, are mixed into a dough. The salt is added after the first half of the kneading time. After proofing, the dough is reworked and divided and loaves are formed. Before baking, the loaves are brushed with water and sprinkled with flour.

**Parameters**

- **Kneading**
  - Spiral kneading system: 4 min 1st gear
  - 5 min 2nd gear
- **Dough proofing:** 60 min
- **Dough temperature:** 22-24 °C
- **Loaf proofing:** 30 min

- **Baking**
  - Oven: Dutch-type oven
  - Baking temperature: 250/220 °C
  - Baking time: 50-60 min

**Application information**

100 g of bread contains 90 mg of omega-3 LC-PUFAs

Estimated baking loss: 10%

Shelf life: approx. 5 d at room temperature

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Food Enrichment with ROPUFA®

White bread

Product information

ROPUFA Food Powder fortification level: 1.0%
Typical serving: 100 g
Omega-3 LC-PUFA content: 90 mg/serving

Preparation

The yeast is dissolved in part of the water. All ingredients, including ROPUFA ‘10’ n-3 Food Powder, are mixed into a dough. The salt is added at the end of the kneading time. After proofing, the dough is reworked, divided and loaves are formed. Before baking, the loaves are brushed with water.

Parameters

- **Kneading**
  - Spiral kneading system: 5-6 min 1st gear
  - 3-4 min 2nd gear
  - Dough proofing: 30 min
  - Dough temperature: 22-24 °C
  - Loaf proofing: 20 min

- **Baking**
  - Oven: Dutch-type oven
  - Baking temperature: 250/220 °C
  - Baking time: 40 min

Application information

100 g of bread contains 90 mg of omega-3 LC-PUFAs
Estimated baking loss: 10%
Shelf life: approx. 3 d at room temperature

Ingredients

<table>
<thead>
<tr>
<th>(g)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour, type 550</td>
<td>100.0</td>
</tr>
<tr>
<td>Water</td>
<td>68.0</td>
</tr>
<tr>
<td>Yeast</td>
<td>5.0</td>
</tr>
<tr>
<td>Salt</td>
<td>2.0</td>
</tr>
<tr>
<td>ROPUFA ‘10’ n-3 Food Powder</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Food Enrichment with ROPUFA®

Toast

**Product information**

ROPUFA Food Oil fortification level: 0.35%
ROPUFA Food Powder fortification level: 1.0%
Typical serving: 100 g
Omega-3 LC-PUFA content: 90 mg/serving

**Ingredients**

Using ROPUFA ‘30’ n-3 Food Oil: (g)
- Wheat flour, type 550: 100.00
- Water: 60.00
- Yeast: 5.00
- Salt: 2.00
- Fat or butter: 9.43
- ROPUFA ‘30’ n-3 Food Oil: 0.57
- Malt: 1.00
- Baking powder: 2.50

Using ROPUFA ‘10’ n-3 Food Powder:
- Wheat flour, type 550: 100.00
- Water: 60.00
- Yeast: 5.00
- Salt: 2.00
- Fat or butter: 10.00
- ROPUFA ‘10’ n-3 Food Powder: 1.64
- Malt: 1.00
- Baking powder: 2.50

**Notes on ingredients**

- Baking powder: emulsifying baking powder

**Preparation**

The yeast is dissolved in part of the water. All ingredients, including the ROPUFA ‘10’ n-3 Food Powder or ROPUFA ‘30’ n-3 Food Oil, are mixed into a dough. The salt is added at the end of the kneading time. The dough is then reworked, divided and placed in baking tins for proofing. After baking, the loaves are removed from the mould immediately.

**Parameters**

- **Kneading**
  - Spiral kneading system: 5-6 min 1st gear 3-4 min 2nd gear
  - Dough proofing: none
  - Dough temperature: 22-24 °C
  - Loaf proofing: 40 min

- **Baking**
  - Oven: Dutch-type oven
  - Baking temperature: 220 °C
  - Baking time: 35-40 min

**Application information**

100 g of toast contains 90 mg of omega-3 LC-PUFAs
Estimated baking loss: 10%
Shelf life: approx. 1 week at room temperature

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Chocolate cake 20% fat

Product information

ROPUFA Food Oil fortification level:
1.0% in dough
ROPUFA Food Powder fortification level:
3.0% in dough
Typical serving: 100 g
Omega-3 LC-PUFA content: 250 mg/serving

Ingredients

Using ROPUFA ‘30’ n-3 Food Oil (g)
Wheat flour, type 400 250.0
Sugar (sucrose) 150.0
Butter 116.7
ROPUFA ‘30’ n-3 Food Oil 8.3
Egg yolk 50.0
Egg white 81.5
Milk 62.5
Baking powder 7.5
Dark chocolate 100.0

Using ROPUFA ‘10’ n-3 Food Powder
Wheat flour, type 400 225.1
ROPUFA ‘10’ n-3 Food Powder 24.9
Sugar 150.0
Butter 125.0
Egg yolk 50.0
Egg white 81.5
Milk 62.5
Baking powder 70.5
Dark chocolate 100.0

Notes on ingredients

- Wheat flour type 400 equals extra-short flour.

Preparation

Using ROPUFA ‘30’ n-3 Food Oil
The egg yolk and sugar are whipped to a foam. The butter and Food Oil are stirred in. The wheat flour and baking powder are premixed and added. The mixture is stirred until it is homogeneous and the melted chocolate is stirred in. The egg white is beaten stiff and softly mixed into the batter, which is then filled into a baking tin and baked.

Using ROPUFA ‘10’ n-3 Food Powder
The egg yolk and the sugar are whipped to a foam. The butter is stirred in. The wheat flour, baking powder and Food Powder are premixed and added. The mixture is stirred until it is homogeneous and the melted chocolate is stirred in. The egg white is beaten stiff and softly mixed into the batter, which is then filled into a baking tin and baked.

Baking parameters

- Oven: Fan oven
- Baking temperature: 190 °C
- Baking time: 35-40 min
- Baking loss: <5%

Application information

- Shelf life: approx. 1 week at room temperature

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Food Enrichment with ROPUFA®

Yoghurt cake

Product information

ROPUFA Food Oil fortification level: 1.0%
Typical serving: 100 g
Omega-3 LC-PUFA content: 250 mg/serving

Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour, type 550</td>
<td>310.0</td>
</tr>
<tr>
<td>Sugar incl. vanilla sugar</td>
<td>240.0</td>
</tr>
<tr>
<td>Whole egg (liquid)</td>
<td>200.0</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>170.0</td>
</tr>
<tr>
<td>Fat or oil</td>
<td>60.9</td>
</tr>
<tr>
<td>Baking powder</td>
<td>10.0</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>9.1</td>
</tr>
</tbody>
</table>

Notes on ingredients

- Baking powder: E450a

Preparation

The ROPUFA ‘30’ n-3 Food Oil is added to the melted fat or mixed with the oil. The yoghurt is mixed with the sugar, vanilla sugar and eggs, the mixture of ROPUFA and fat or oil is added, and then the flour and baking powder. The dough is mixed for at least 5 min at medium speed. The batter is then spread into cake tins, and baked in an oven.

Baking parameters

- Oven: Fan oven
- Baking temperature: 190 °C
- Baking time: 40 min

Application information

100 g of cake contains 250 mg of omega-3 LC-PUFAs

- Estimated baking loss: 10%
- Shelf life: approx. 1 week at room temperature

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Food Enrichment with ROPUFA®

Cookies

Product information

ROPUFA Food Oil fortification level: 1.0%
ROPUFA Food Powder fortification level: 1.5%
Typical serving: 25 g
Omega-3 LC-PUFA content:
62.5 mg/serving (oil)
33.8 mg/serving (powder)

Ingredients

Using ROPUFA ‘30’ n-3 Food Oil (g)
Wheat flour, type 550 410.0
Sugar 205.0
Fat or butter 195.9
ROPUFA ‘30’ n-3 Food Oil 9.1
Whole egg (liquid) 180.0
Lemon flavour q.s.
Baking powder q.s.

Using ROPUFA ‘10’ n-3 Food Powder
Wheat flour, type 550 396.3
ROPUFA ‘10’ n-3 Food Powder 13.7
Fat or butter 205.0
Sugar 205.0
Whole egg (liquid) 180.0
Lemon flavour q.s.
Baking powder q.s.

Preparation

Using ROPUFA ‘30’ n-3 Food Oil
The ROPUFA ‘30’ n-3 Food Oil is added to the melted fat. All other ingredients are slowly mixed in to form a sweet short pastry. The pastry is then kept cool at 4 °C for at least 2 h before being rolled to a thickness of approx. 5 mm. Pieces are cut out and brushed with egg yolk before baking.

Using ROPUFA ‘10’ n-3 Food Powder
The ROPUFA ‘10’ n-3 Food Powder is mixed with the flour. All other ingredients are mixed slowly, starting with the fat, to form a sweet short pastry. The pastry is kept cool at 4 °C for at least 2 h before being rolled to a thickness of approx. 5 mm. Pieces are cut out and brushed with egg yolk before baking.

Baking parameters
Oven: Fan oven
Baking temperature: 180 °C
Baking time: 15 min

Application information

100 g of cookies contains 250 mg (oil) or 135 mg (powder) of omega-3 LC-PUFAs
Estimated baking loss: 10%
Shelf life: approx. 3 months sealed in aluminium bags at room temperature

Notes on ingredients

- Flavour from Givaudan Roure Ltd
- Baking powder: E450a

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## Wholemeal biscuits

### Product information

ROPUFA Food Oil fortification level: 2.0%
Typical serving: 25 g
Omega-3 LC-PUFA content: 125 mg/serving

### Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole wheat flour</td>
<td>355.0</td>
</tr>
<tr>
<td>Fat</td>
<td>195.3</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>18.2</td>
</tr>
<tr>
<td>Cane sugar</td>
<td>177.5</td>
</tr>
<tr>
<td>Almonds, ground</td>
<td>118.0</td>
</tr>
<tr>
<td>Whole egg (liquid)</td>
<td>130.0</td>
</tr>
<tr>
<td>Salt</td>
<td>1.0</td>
</tr>
<tr>
<td>Baking powder</td>
<td>2.5</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>2.5</td>
</tr>
<tr>
<td>Lemon peel flavour</td>
<td>q.s.</td>
</tr>
<tr>
<td>Lemon juice</td>
<td>q.s.</td>
</tr>
</tbody>
</table>

### Notes on ingredients

- Baking agent: E450a

### Preparation

The ROPUFA ‘30’ n-3 Food Oil is added to the melted fat. All other ingredients are mixed in to form a sweet short pastry. The pastry is then kept cold (4 °C) for at least 2 h before being rolled to a thickness of approx. 6 mm. Pieces are cut out, brushed with egg yolk and sprinkled with cane sugar before baking.

### Baking parameters

- Oven: Fan oven
- Baking temperature: 200 °C
- Baking time: 10 min

### Application information

100 g of wholemeal biscuits contains 500 mg of omega-3 LC-PUFAs

Estimated baking loss 10%

Shelf life: approx. 1 month sealed in aluminium bags at room temperature

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## Food Enrichment with ROPUFA®

### Table margarine 60% fat

<table>
<thead>
<tr>
<th>Product information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROPUFA Food Oil fortification level: 3.0%</td>
</tr>
<tr>
<td>Typical serving: 30 g</td>
</tr>
<tr>
<td>Omega-3 LC-PUFA content: 225 mg/serving</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fat phase</strong></td>
</tr>
<tr>
<td>The fats are melted, but the temperature must not exceed 60 °C. The oil is added and kept at the same temperature. Shortly before processing, the ROPUFA ‘30’ n-3 Food Oil and all other oil-soluble ingredients are added to the fat-oil mixture.</td>
</tr>
</tbody>
</table>

| **Water phase** |
| All water-soluble ingredients are dissolved in water and pasteurized. |
| The water phase is added slowly to the oil phase (50 °C) and mixed with a high-shear mixer to form a homogeneous emulsion. The emulsion is crystallized in a margarine plant, equipped with a votator, pinworker and resting tube. The margarine is filled into tubs at 20 °C and afterwards stored in a cool place. |

<table>
<thead>
<tr>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fat phase</strong></td>
</tr>
<tr>
<td>Fat phase</td>
</tr>
<tr>
<td>Sunflower oil</td>
</tr>
<tr>
<td>Mixture of hydrogenated rapeseed, soy, coconut and palm fat</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
</tr>
<tr>
<td>Emulsifier</td>
</tr>
<tr>
<td>beta-Carotene 30% FS</td>
</tr>
<tr>
<td>Butter flavour, oil soluble</td>
</tr>
</tbody>
</table>

| **Water phase** |
| Water | 39.858 |
| Salt | 0.100 |
| Citric acid | 0.042 |

<table>
<thead>
<tr>
<th>Notes on ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Emulsifier: mono- and diglyceride of fatty acids, MDG (E471)</td>
</tr>
<tr>
<td>■ beta-Carotene 30% Suspension and citric acid from F. Hoffmann-La Roche Ltd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application information</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 g of margarine contains 750 mg of omega-3 LC-PUFAs</td>
</tr>
<tr>
<td>The mixture of fat depends on the desired fatty acid profile and texture</td>
</tr>
<tr>
<td>Shelf life: approx. 3 months at 4 °C</td>
</tr>
</tbody>
</table>

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Food Enrichment with ROPUFA®

Table margarine 80% fat

Product information

ROPUFA Food Oil fortification level: 3.0%
Typical serving: 30 g
Omega-3 LC-PUFA content: 225 mg/serving

Preparation

Fat phase
The fats are melted, but the temperature must not exceed 60 °C. The oil is added and kept at the same temperature. Shortly before processing, the ROPUFA ‘30’ n-3 Food Oil and all other oil-soluble ingredients are added to the fat-oil mixture.

Water phase
All water-soluble ingredients are dissolved in water and pasteurized.

The water phase is added slowly to the oil phase (50 °C) and mixed with a high-shear mixer to form a homogeneous emulsion. The emulsion is crystallized in a margarine plant, equipped with a votator, pinworker and resting tube. The margarine is filled into tubs at 15 °C and afterwards stored in a cool place.

Application information

100 g of margarine contains 750 mg of omega-3 LC-PUFAs
The mixture of fat depends on the desired fatty acid profile and texture
Shelf life: approx. 3 months stored at 4 °C

Ingredients

<table>
<thead>
<tr>
<th>Fat phase</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower oil</td>
<td>30.850</td>
</tr>
<tr>
<td>Mixture of hydrogenated rapeseed, soy, coconut and palm fat</td>
<td>45.800</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>3.000</td>
</tr>
<tr>
<td>Emulsifier</td>
<td>0.250</td>
</tr>
<tr>
<td>beta-Carotene 30% FS</td>
<td>0.008</td>
</tr>
<tr>
<td>Butter flavour, oil soluble</td>
<td>0.090</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Salt</td>
</tr>
<tr>
<td>Citric acid</td>
</tr>
<tr>
<td>Butter flavour, water soluble</td>
</tr>
</tbody>
</table>

Notes on ingredients

- Emulsifier: mono- and diglyceride of fatty acids, MDG (E471)
- beta-Carotene 30% Suspension and citric acid from F. Hoffmann-La Roche Ltd

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Food Enrichment with ROPUFA®

UHT milk drink 1.7% fat

Product information

ROPUFA Food Oil fortification level: 0.2%
Typical serving: 300 mL
Omega-3 LC-PUFA content: 150 mg/serving

Preparation

Pre-emulsion

Part I is mixed and homogenized in a high-pressure homogenizer ($p_1 = 150$ bar, $p_2 = 50$ bar) at 40 °C to form a homogeneous emulsion.

UHT Procedure

The ingredients are mixed. The mix is pre-heated by heat exchanger to 80 °C, followed by thermal processing, using direct steam injection, to 140 °C for 4 s and vacuum-cooling to 80 °C. It is then homogenized in a high-pressure homogenizer ($p_1 = 150$ bar, $p_2 = 50$ bar), followed by cooling to 10-15 °C and aseptic filling.

Application information

Milk-fat content: 1.5%
Shelf life: approx. 3 months in Tetrapak at room temperature

Ingredients

<table>
<thead>
<tr>
<th>Part I</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROPUFA '30' n-3 Food Oil</td>
<td>0.200</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
<td>2.580</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
</tr>
</tbody>
</table>

Notes on Ingredients

- Sodium ascorbate from F. Hoffmann-La Roche Ltd

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Strawberry UHT milk drink 1.7% fat

**Product information**

ROPUFA Food Oil fortification level: 0.2%
Typical serving: 300 mL
Omega-3 LC-PUFA content: 150 mg/serving

**Preparation**

**Pre-emulsion**

Part I is mixed and homogenized in a high-pressure homogenizer \((p_1 = 150 \text{ bar}, \ p_2 = 50 \text{ bar})\) at 40 °C.

**UHT Procedure**

The ingredients are mixed. The mix is pre-heated by heat exchanger to 80 °C, followed by thermal processing using direct steam injection to 140 °C for 4 s and vacuum-cooling to 80 °C. It is then homogenized in a high-pressure homogenizer \((p_1 = 150 \text{ bar}, \ p_2 = 50 \text{ bar})\), followed by cooling to 10-15 °C and aseptic filling.

**Application information**

Milk-fat content: 1.5%
Shelf life: approx. 3 months in Tetrapak at room temperature

**Ingredients**

<table>
<thead>
<tr>
<th>Part I</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>0.200</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
<td>2.578</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
</tr>
<tr>
<td>Sugar</td>
</tr>
<tr>
<td>Color (carmine)</td>
</tr>
<tr>
<td>Color (lutein)</td>
</tr>
<tr>
<td>Stabilizer</td>
</tr>
<tr>
<td>Strawberry flavour powder</td>
</tr>
</tbody>
</table>

**Notes on Ingredients**

- Stabilizer: carrageenan
- Sodium ascorbate from F. Hoffmann-La Roche Ltd
Food Enrichment with ROPUFA®

Chocolate UHT milk drink 1.8% fat

Product information

ROPUFA Food Oil fortification level: 0.2%
Typical serving: 300 mL
Omega-3 LC-PUFA content: 150 mg/serving

Preparation

Pre-emulsion

Part I is mixed and homogenized in a high-pressure homogenizer (p₁ = 150 bar, p₂ = 50 bar) at 40 °C.

UHT Procedure

The ingredients are mixed. The mix is preheated by heat exchanger to 80 °C, followed by thermal processing using direct steam injection to 140 °C for 4 s and vacuum cooling to 80 °C. It is then homogenized in a high-pressure homogenizer (p₁ = 150 bar, p₂ = 50 bar), followed by cooling to 10-15 °C and aseptic filling.

Application information

Milk-fat content: 1.5%
Shelf life: approx. 3 months in Tetrapak at room temperature

Ingredients

<table>
<thead>
<tr>
<th>Part I</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>0.200</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
<td>2.578</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
</tr>
<tr>
<td>Sodium ascorbate</td>
</tr>
<tr>
<td>Milk 1.5% fat</td>
</tr>
<tr>
<td>Sugar</td>
</tr>
<tr>
<td>Chocolate powder</td>
</tr>
<tr>
<td>Stabilizer</td>
</tr>
</tbody>
</table>

Notes on ingredients

- Stabilizer: carrageenan
- Sodium ascorbate from F. Hoffmann-La Roche Ltd

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**Instant chocolate milk drink**

**Product information**

ROPUFA Food Powder fortification level: 0.1%
Typical serving: 500 mL
Omega-3 LC-PUFA content: 45 mg/serving

**Preparation**

**Chocolate powder mix**
- Mix all dry ingredients and sieve.

**Chocolate milk drink**
- Mix powder into cold milk.
- Stir until evenly dispersed.

**Application information**

100 g of instant chocolate powder contains 145 mg of omega-3 LC-PUFAs
Shelf life: max. 12 months in aluminium bags at room temperature

**Ingredients**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate powder mix</td>
<td>33.2</td>
</tr>
<tr>
<td>Sugar, fine</td>
<td>55.7</td>
</tr>
<tr>
<td>Maltodextrin</td>
<td>20.1</td>
</tr>
<tr>
<td>Cocoa powder</td>
<td>22.3</td>
</tr>
<tr>
<td>Salt</td>
<td>0.3</td>
</tr>
<tr>
<td>ROPUFA ‘10’ n-3 Food Powder</td>
<td>1.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate milk drink</td>
<td></td>
</tr>
<tr>
<td>Chocolate powder mix</td>
<td>33.2</td>
</tr>
<tr>
<td>Milk</td>
<td>466.8</td>
</tr>
</tbody>
</table>
Food Enrichment with ROPUFA®

Yoghurt (stirred type) 3.5% fat

**Product information**

ROPUFA Food Oil fortification level: 0.6%
Typical serving: 150 g
Omega-3 LC-PUFA content: 225 mg/serving

**Preparation**

The milk is heated to 35 °C and the milk powder, stabilizer and sugar are mixed in. This mixture is heated to 65 °C to dissolve all ingredients, and homogenized in a high-pressure homogenizer (p₁ = 150 bar, p₂ = 50 bar) at 65 °C. This emulsion is then pasteurized at 80 °C for 20 min. After cooling to 45 °C the plain yoghurt or yoghurt culture is added and mixed, followed by incubation at 45 °C for 3-4 h until a pH of 4.3 is reached. After cooling and vigorous stirring, the yoghurt is filled into cups, sealed and stored at 4 °C.

**Method A**

Addition of the ROPUFA ‘30’ n-3 Food Oil before homogenization.

**Method B**

Addition of the ROPUFA ‘30’ n-3 Food Oil after fermentation during stirring.

**Application information**

100 g of yoghurt contains 150 mg of omega-3 LC-PUFAs

Shelf life: approx. 3 weeks at 4 °C

**Ingredients**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-fat milk (3.8% fat)</td>
<td>78.8</td>
</tr>
<tr>
<td>Skimmed milk (0.1% fat)</td>
<td>10.8</td>
</tr>
<tr>
<td>Skimmed-milk powder</td>
<td>2.0</td>
</tr>
<tr>
<td>Stabilizer</td>
<td>0.3</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.0</td>
</tr>
<tr>
<td>Plain yoghurt or yoghurt culture</td>
<td>2.5</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Notes on ingredients**

- Stabilizer: gelatin, starch, sugar, agar agar (E406)

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Food Enrichment with ROPUFA®

Fruit yoghurt (stirred type) 3.5% fat

Product information

ROPUFA Food Oil fortification level: 0.6%
Typical serving: 150 g
Omega-3 LC-PUFA content: 225 mg/serving

Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-fat milk (3.8% fat)</td>
<td>78.8</td>
</tr>
<tr>
<td>Skimmed milk (0.1% fat)</td>
<td>10.8</td>
</tr>
<tr>
<td>Skimmed-milk powder</td>
<td>2.0</td>
</tr>
<tr>
<td>Stabilizer</td>
<td>0.3</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.0</td>
</tr>
<tr>
<td>Yoghurt or yoghurt culture</td>
<td>2.5</td>
</tr>
<tr>
<td>ROPUFA '30' n-3 Food Oil</td>
<td>0.6</td>
</tr>
<tr>
<td>Fruit preparation q.s.</td>
<td></td>
</tr>
</tbody>
</table>

Notes on ingredients

- Stabilizer: gelatin, starch, sugar, agar agar (E406)
- Fruit preparation: e.g. strawberry

Preparation

The milk is heated to 35 °C and the milk powder, stabilizer and sugar are mixed in. This mixture is heated to 65 °C to dissolve all ingredients, and homogenized in a high-pressure homogenizer ($p_1 = 150$ bar; $p_2 = 50$ bar) at 65 °C. This emulsion is then pasteurized at 80 °C for 20 min. After cooling to 45 °C the plain yoghurt or yoghurt culture is added and mixed, followed by incubation at 45 °C for 3-4 h until a pH of 4.3 is reached. After cooling and vigorous stirring, the fruit preparation is added and mixed. The fruit yoghurt is filled into cups, sealed and stored at 4 °C.

Method A

Addition of ROPUFA ‘30’ n-3 Food Oil before homogenization.

Method B

Addition of ROPUFA ‘30’ n-3 Food Oil after fermentation during stirring.

Application information

100 g of yoghurt contains 150 mg of omega-3 LC-PUFAs in the yoghurt part

Depending on quantity and composition of the fruit preparation, the contents of fat, LC-PUFAs and non-fat milk solids will vary

Shelf life: approx. 3 weeks at 4 °C

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Food Enrichment with ROPUFA®

Yoghurt (set type) 3.5% fat

Product information

ROPUFA Food Oil fortification level: 0.6%
Typical serving: 150 g
Omega-3 LC-PUFA content: 225 mg/serving

Preparation

The milk is heated to 35 °C and the milk powder and sugar are added. This mixture is heated to 65 °C to dissolve all ingredients. The ROPUFA ‘30’ n-3 Food Oil is added, and the mixture is homogenized in a high-pressure homogenizer (p₁ = 150 bar, p₂ = 50 bar) at 65 °C. This emulsion is then pasteurized at 80 °C for 20 min. After cooling to 45 °C the plain yoghurt or yoghurt culture is mixed in. This mixture is filled into cups. The cups are sealed and incubated at 45 °C for 3-4 h until a pH of 4.3 is reached. The product is then cooled and stored at 4 °C.

Application information

100 g of yoghurt contains 150 mg of omega-3 LC-PUFAs
Shelf life: approx. 3 weeks at 4 °C

Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-fat milk (3.8% fat)</td>
<td>75.0</td>
</tr>
<tr>
<td>Skimmed milk (0.1% fat)</td>
<td>14.9</td>
</tr>
<tr>
<td>Skimmed-milk powder</td>
<td>2.0</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.0</td>
</tr>
<tr>
<td>Plain yoghurt or yoghurt culture</td>
<td>2.5</td>
</tr>
<tr>
<td>ROPUFA ‘30’ n-3 Food Oil</td>
<td>0.6</td>
</tr>
</tbody>
</table>

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**Product Information**

ROPUFA Food Oil fortification level: 0.6%
Typical serving: 150 g
Omega-3 LC-PUFA content: 225 mg/serving

**Preparation**

The milk is heated to 35 °C and the milk powder and sugar are mixed in. This mixture is heated to 65 °C to dissolve all ingredients. The ROPUFA ‘30’ n-3 Food Oil and the fruit preparation are added to the mixture, which is then homogenized in a high-pressure homogenizer (p₁ = 150 bar; p₂ = 50 bar) at 65 °C. This emulsion is then pasteurized at 80 °C for 20 min. After cooling on top of the fruit preparation, the cups are sealed and incubated at 45 °C for 3-4 h until a pH of 4.3 is reached in the yoghurt part. The product is then cooled, and stored at 4 °C.

**Application information**

100 g of yoghurt contains 150 mg of omega-3 LC-PUFAs in the yoghurt part.
Depending on the quantity and composition of the fruit preparation, the contents of fat, LC-PUFAs and non-fat milk solids will vary.

Shelf life: approx. 3 weeks at 4 °C
Recommended Reading

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Very low intakes of n-3 fatty acids incorporated into bovine milk reduce plasma triacylglycerol and increase HD-cholesterol concentrations in healthy subjects.
Pharmacological Research 41, 571-576 (2000)
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