AAK – the preferred partner in fats for Infant Nutrition
Understanding customer needs is our business
AAK is a world leading supplier of high value-added specialty fats. In every customer relationship, our role is to contribute to the competitiveness of our customers in their respective markets. We offer a wide range of product advantages; from highly nutritional products, products developed for better taste and longer shelf life, to cost efficiency.

Company
AAK’s wide product portfolio meets customer requirements worldwide. Our customers represent a wide range of industries; Food, Infant Nutrition, Confectionery, Cosmetics, Technical and Feed. AAK’s objective is to supply innovative and creative, vegetable fat solutions for the benefit of our customers.

Products tailored for your needs
AAK offers a complete range of oils and fats for infant nutrition. The Akonino range consists of blends with a specific fatty acid profile tailored to the customer needs.

Quality and Food safety
AAK’s quality comprises the entire product chain – from raw material to finished product. All of AAK’s production units are certified according to international standard’s. HACCP is one of the tools used in order to secure a high level of product safety.

Research & Development
AAK’s knowledge and expertise regarding the properties of vegetable fats develop continuously through customer contacts, cooperation with research institutes and governmental authorities – regionally and globally. Our research and development take place in close coordination with the customer to tailor products to meet the customer’s requirements.

AAK ACADEMY™
AAK’s customer training programme is organised by AAK ACADEMY™. The Academy arranges courses and seminars for entire industries as well as for individual customers. The purpose of the training is to make it easier for our customers to control the functionality of the fat in their own product.

For further information see www.aak.com

Breast milk – the golden standard
The composition of breast milk is such that it supplies the energy and components necessary for growth and development of the baby. The main components are: lactose, fats and proteins. In addition to this it is a source of minor components that are essential for the healthy development of the baby.

The fatty acid composition of breast milk is influenced by a number of factors. It changes during the breastfeeding period, but it also depends on the time of day and the eating habits of the mother. A typical fatty acid composition can be found on page 4.

Energy
Fat is the main source of energy in the breast milk. About 50 % of the dietary calories are supplied to newborns as fat. Breast milk has a fat content of 3-5 %

Essential fatty acids
The fat in breast milk is also the source of the essential fatty acids. These fatty acids: linoleic acid (C18:2) and α-linolenic acid (C18:3) can not be synthesized by the human body.

Fats in Infant Nutrition
- Energy
- Essential fatty acids
- LC PUFA
- β-palmitate

Long Chain PolyUnsaturated Fatty Acid (LC PUFA)
The essential fatty acid are the basis for the formation of the so called Long Chain PolyUnsaturated Fatty Acids (LC PUFA). These have essential roles in the signaling system and in the cell membranes, especially in the brain and the eye development. When infants intake of LC PUFA is zero the conversion from the essential fatty acids to LC PUFA might be insufficient.

β-palmitate
The triglyceride molecule of breast milk fat has a specific composition (the same in humans all over the world), with a saturated palmitic fatty acid (C16:0) in the central, (sn-2 or β) position and mainly unsaturated fatty acids (C18:1) in the outer (sn-1,3 or α) positions in the triglyceride. A glyceride with palmitic fatty acid in the β position is called β-palmitate.

The benefits of this triglyceride is explained more in detail on page 6-7.
Quality and standards
AAK is well known for its high level of product quality and food safety. During 100 years of processing mild but effective processing has been developed to give pure and fresh oils. Processing is designed to give good oxidation stability and bland taste. In addition process conditions have been optimized to ensure that oils are free from undesirable components.

Working procedures and instructions are in place for the entire supply chain from raw material suppliers to finished product. These are part of our quality assurance systems and have been verified by third party auditors against international standards.

AAK Certificates

<table>
<thead>
<tr>
<th>Certificate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 9001</td>
<td>Quality</td>
</tr>
<tr>
<td>ISO 22000</td>
<td>Food Safety</td>
</tr>
<tr>
<td>ISO 14001</td>
<td>Environment</td>
</tr>
</tbody>
</table>

Kosher Products
Halal Products
Organic Products

Product safety
Our approach to food safety is proactive and preventive and covers the whole supply chain. A detailed HACCP plan is in operation in our plants. We have defined our internal standard of contaminants, which in many cases goes beyond legal requirements for potential hazardous contaminants. Key elements in assuring compliance are:

- Supplier audits; raw materials are only bought from suppliers who have been audited and approved by our in-house team of trained and experienced auditors.
- Change procedures in our processing; a “food safety team” supervises and approves all changes in processing conditions to ensure that food safety is not affected.
- Process validation; optimization of process conditions to ensure removal of undesirable components.
- Monitoring programme; regular monitoring of purity of raw materials and finished products to identify new potential hazards and verify functionality of all our control measures.
Breast milk – the reference
The reference for infant formula is breast milk. An important aim is therefore to mimic the fat composition of human breast milk. To achieve this, a number of different oils needs to be blended. AAK has a long experience in supplying tailor made blends to infant formula producers under the Akonino brand name.

Specified fat composition
A tailor made blend for an infant formula may comprise up to five components of specified proportions, in order to come as close as possible to the fat composition in breast milk. Different oils contribute with different fatty acids providing the total composition to be in line with the specification. AAK can provide a wide range of oils to fulfill any requirement on composition.

Saturated fat from palm and laurics
Palm oil provides palmitic acid, which is the predominant saturated fatty acid. To reach the level of 20-25% found in breast milk, 40-50% palm oil or palm olein is required. To get even closer to breast milk, palm oil should be replaced by InFat™, the product described in pages 6-7.

Essential fatty acids
Furthermore, the formula needs to contain sufficient essential fatty acids. 10-20% rapeseed or soyabean oil delivers the target level of 1-2% of linolenic acid (18:3) and part of the linoleic (18:2).

In most cases at least one more liquid oil is needed to provide the desired levels of linoleic and oleic acid.

Antioxidants
Different antioxidants, such as mixed tocopherols, α-tocopherol, ascorbyl palmitate and lecithin can also be added on request.

Akonino range
Most Akonino products are tailor made in cooperation with the customer, some examples of standard products are described below.

<table>
<thead>
<tr>
<th>Fatty acid profile (%)</th>
<th>Breast milk</th>
<th>Akonino NS</th>
<th>Akonino NR</th>
<th>Akonino SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>C8</td>
<td>0.6</td>
<td>0.5</td>
<td>2.2</td>
<td>30</td>
</tr>
<tr>
<td>C10</td>
<td>1</td>
<td>0.5</td>
<td>1.8</td>
<td>20</td>
</tr>
<tr>
<td>C12</td>
<td>6.2</td>
<td>6</td>
<td>14.7</td>
<td>4.5</td>
</tr>
<tr>
<td>C14</td>
<td>7.8</td>
<td>2.5</td>
<td>5.9</td>
<td>1.5</td>
</tr>
<tr>
<td>C16</td>
<td>25</td>
<td>23</td>
<td>22.5</td>
<td>4.2</td>
</tr>
<tr>
<td>C18:0</td>
<td>8.7</td>
<td>3</td>
<td>3.7</td>
<td>1.4</td>
</tr>
<tr>
<td>C18:1</td>
<td>35.0</td>
<td>42</td>
<td>29.5</td>
<td>14.5</td>
</tr>
<tr>
<td>C18:2</td>
<td>11.0</td>
<td>19</td>
<td>15.6</td>
<td>19.5</td>
</tr>
<tr>
<td>C18:3</td>
<td>1.2</td>
<td>2</td>
<td>1.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Tailor made blends – AAK takes responsibility

Four tanks or one
There are several advantages with using tailor made blends compared to buying single oils and blend in-house. Firstly, the logistical advantage of handling only one oil-blend instead of purchasing individual oils is significant. The supply and demand as well as quality can be optimized. This ensure the oil is consumed in as short time as possible. Buying single oil requires at least one storage tank for each oil. The rate of consumption of the various oils will differ since they are used in different percentages in the blend. The challenge of balancing supply and demand is consequently greater when buying individual oils.

Full truckloads
Freight costs are an important factor in the total cost, and when buying a tailor made blend, full truckloads will keep these costs as low as possible. Transporting the oils separately may, however, induce difficulties to utilize full truckloads. The different oils may have different turnover rates. A slower turnover leads to higher working capital being tied up in raw material storage since more tanks are needed, and it is likely that in average more oil will be stored in the tanks.

Improved quality
Oils used in smaller quantities may also need longer storage time before consumed. This will have a negative impact on product quality since longer storage leads to more oxidative breakdown of the oil. When supplying oil blends we effectively take over the raw material supply and storage for our customers and supply freshly produced oil blends at a rate that matches their rate of consumption.

Guaranteed specification
After agreeing on a specification for the complete blend, AAK will take the responsibility to ensure that the specification is met for each delivery. This saves the extra work for the producer, who has to optimize the composition depending on variations in the raw materials. When buying a tailor made Akonino blend, this optimization is handled by AAK.

Better quality, simpler planning and less working capital make blends a more attractive option than single oils.

Raw materials available from AAK
- Coconut oil
- Palmkernel oil
- Palm and palm oil fractions
- Sunflower oil
- High oleic sunflower oil
- Soya bean oil
- Rapeseed oil
- Corn oil
- High oleic rapeseed oil
- MCT oils

Akonino NS is a typical example of a blend for a standard infant formula, with a composition very close to that of breast milk. In this blend the linolenic acid is supplied by rapeseed oil. Akonino NR is a similar blend where the linolenic acid comes from soyabean oil instead.

Akonino SC is a blend comprising MCT oils, which are used in special formulas for preterm infants. MCT oils are based on short chain fatty acids (C8, C10) and as such are appreciated as an efficient source of energy.

Tailor made Akonino blends
- Better quality
- Guaranteed specification
- Better addition of antioxidants
- Simplified planning
- Improved logistics
- Less working capital
InFat – Closer to human milk
InFat is supplied by Advanced Lipids, joint venture of AAK and Enzymotec.

InFat is an advanced fat ingredient, developed to meet the specific needs of the growing infant. It has a fat composition mimicking that of human milk fat, thereby enabling optimised uptake of calcium and energy and easy digestion. These benefits are the results of the fatty acid composition on the glycerol backbone, which ensures high level of palmitic acid at the middle (sn-2) position. β-palmitate the significance of this fatty acid and its position is evident from the fact that this is conserved in all women, regardless of origin or nutrition, unlike the general fatty acid profile of human milk.

Human milk fat composition
In human breast milk, and in infant formulas, up to 50 % of the dietary calories are supplied to newborns as fat. More than 98 % of this fat is in the form of triacylglycerides, which contain saturated and unsaturated fatty acids esterified to glycerol (1). Fatty acids in human milk-fat have a highly specific positional distribution on the glycerol backbone (2). This specific configuration is known to have a major impact on the efficacy of this nutrient absorption. Palmitic acid (C16:0) is the predominant saturated fatty acid, constituting 17-25 % of the fatty acids in mature human milk. Of the palmitic acid, 70-75 % is esterified to the sn-2 position of the triglyceride β-palmitate (2). In contrast, palmitic acid present in standard vegetable oils is esterified to the sn-1 and sn-3 positions while the sn-2 position is predominantly occupied by unsaturated fatty acids (3).

Human milk fat absorption
When an infant is breast fed, the hydrolysis of dietary triacylglycerols by endogenous lipases produces sn-2 monoacylglycerols and free fatty acids (4). The importance of the positional distribution of the fatty acids in human milk or infant formula fat applies particularly to palmitic acid since it is one of the major constituents and is relatively poorly absorbed as the fatty acid. The unsaturated and short chain saturated fatty acids are well absorbed regardless of their positional distribution (5). The coefficient of absorption of free long chain saturated fatty acids, i.e. palmitic acid and longer, is relatively low (6). This is in part due to their melting point above body temperature (~63°C). The tendency of these fatty acids is to form hydrated fatty acid soaps with minerals such as calcium or magnesium at the pH of the intestine (7).

Absorption of human milk fat compared to standard infant formula
The superior absorption of human milk fat over standard infant formula has been demonstrated in both human (8-10) and animal models (5, 11). These studies showed that palmitic acid is absorbed from human milk as sn-2 monoacylglycerol (9), and conserved as such through digestion, absorption, and chylomicron triacylglycerol
Calcium soap formation may lead to problems with constipation

Formation of calcium soaps in the gut could be associated with the considerable differences of bowel habit and stool consistency between human milk and formula-fed infants (14). Formula feeding is associated with constipation in both term and preterm infants which, for the latter, can lead to severe complications. In contrast, constipation is rare in breast fed term infants, suggesting different handling of saturated fatty acids.

**InFat – closer to human milk**

By using a patented enzymatic process, InFat has been developed to resemble the unique structure of the fat in human milk. InFat is based purely on vegetable oils, but the triglyceride structure has been transformed to mimic human milk – leading to better fat and calcium absorption by the infant.

The palmitic acid in InFat is to a large extent positioned in the second (sn-2) position on the triglyceride β-palmitate, just as in human milk (Figure 3). Clinical studies have shown that infants fed formula based on structured fats with a high level of palmitic acid in the sn-2 position have softer stools compared to infants fed standard vegetable oil formula (15). It has also been shown that the absorption of palmitic acid is improved when using structured fats, as is calcium absorption (8, 16-19). Evidently β-palmitate leads to efficient fat absorption and avoidance of soap formation with calcium (20).

There is also an effect on the whole-body-bone mass of the infants; it is significantly increased compared to a standard vegetable oil infant formula (15). This suggests that the formula composition may affect the skeletal mineral deposition in infants.

**References**


**InFat Benefits**

- Constipation is reduced, leading to softer stools and fewer stomach problems
- Calcium uptake is increased, resulting in higher body-bone mass
- Energy uptake is increased, which is very important for a growing baby.

**Figure 2 Vegetable Fat Absorption**

**Figure 3 The InFat Solution**

**References**


Organic oils and infant formula blends

The trend
Today’s consumers are more and more concerned about the way they live. Living a healthy life is reflected in the choice of what people are eating and where their food is coming from. People want to improve their well-being and to take care of the environment at the same time. Quality of life is therefore not only reflected on their own life, but also on what people see and experience around them.

Organic food fits perfectly into this trend. This is the reason why AAK has developed an entire range of organic oils and formulated blends.

Why choose organic?
The use of chemical fertilizers, pesticides and herbicides is not allowed. Organic products therefore contribute to a sustainable production and help to improve the environment.

Quality
The whole chain of organic products is strictly controlled. An independent part, a certifying body, supervises AAK’s suppliers of organic raw materials and the production of high quality vegetable oils at AAK itself.

The organic raw materials used by AAK are carefully selected and safety aspects are constantly evaluated along the whole production chain. This enables AAK to produce high quality organic oils.

Based on a broad range of organic raw materials AAK has the possibility to tailor making formulations for the infant formula industry. Excellent taste and functionality are essential properties of ingredients. AAK offers its technological expertise of lipids and application know-how to formulate organic products together with our customers. We can also provide you with an organic Akonino blended product.

<table>
<thead>
<tr>
<th>AAK Organic Range</th>
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</thead>
<tbody>
<tr>
<td>Organic Palm oil</td>
</tr>
<tr>
<td>Organic Palm olein</td>
</tr>
<tr>
<td>Organic Palm stearine</td>
</tr>
<tr>
<td>Organic Sunflower oil</td>
</tr>
<tr>
<td>Organic Palmkernel oil</td>
</tr>
<tr>
<td>Organic Coconut oil</td>
</tr>
<tr>
<td>Organic Rapeseed oil</td>
</tr>
<tr>
<td>Akonino Organic</td>
</tr>
</tbody>
</table>
Long Chain PolyUnsaturated Fatty Acids (LC PUFA)

Long Chain PolyUnsaturated Fatty Acids (LC PUFA) consist of ω-3 and ω-6 polyunsaturated fatty acids with a carbon chain length of 20 or more. The most commonly mentioned are eicosapentaenoic acid (EPA, ω-3), docosahexaenoic acid (DHA, ω-3) and arachidonic acid (AA, ω-6).

LC PUFA can be converted from the essential fatty acids α-linolenic acid (ALA, ω-3) and linoleic acid (LA, ω-6) through enzymatic chain elongation and desaturation, in the human body.

When infants intake of LC PUFA is zero the conversion rate from the essential fatty acids to LC PUFA can be insufficient. A sign of this is that LC PUFA levels in plasma and red blood cells decline compared to intake of breast milk or supplemented infant formulas.

According to the EU directive 2006/141/EC addition of LC PUFA is allowed in infant formulas.

Benefits of LC PUFA
Breast milk contain a certain amount of LC PUFA, but the levels do depend on the mothers diet and lifestyle. There are available evidence which support addition of DHA and AA to infant formulas and recommendations have been set [1,2,3].

In the body DHA is found in high concentrations in the brain and in the retina and both DHA and AA are active membrane components. Studies show that addition of DHA and AA to the infant formula supports;
- Visual development
- Brain development
- Cognitive development

Other benefits which may be influenced by supplementation of DHA and AA are;
- Motor development
- Lower blood pressure
- Modulate immune response

Addition of LC PUFA
According to EC legislation you can add LC PUFA to your infant formula under certain limitations. Together with the given recommendations the limits are;
- The addition of DHA needs to be above 0.2 % and recommended to be below 0.5 % of the fatty acids.
- The maximum level including other ω-3 LC PUFA is limited to 1 %.
- EPA needs to be lower than the content of DHA.
- The ω-6 LC PUFA content is limited to 2 % of which AA can be maximum 1 %.
- The content of AA needs to be equal or higher than of the DHA.

Several studies indicate positive influence of the use of LC PUFA in the diet also for the second six months of life.

<table>
<thead>
<tr>
<th>LC PUFA’s Name</th>
<th>Abbreviation</th>
<th>LC PUFA</th>
<th>Chemical composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docosahexaenoic acid</td>
<td>DHA</td>
<td>ω-3</td>
<td>C 22:6</td>
</tr>
<tr>
<td>Eicosapentaenoic acid</td>
<td>EPA</td>
<td>ω-3</td>
<td>C 20:5</td>
</tr>
<tr>
<td>Arachidonic acid</td>
<td>AA</td>
<td>ω-6</td>
<td>C 20:4</td>
</tr>
</tbody>
</table>

References
Legislations and directives

There is a strong regulation, regarding infant formulae. As this is the only processed food satisfying the needs of a growing baby. It varies between different countries hereby illustrated by the EC regulation.

Infant formulae for different ages

Infant formulae can be divided in a number of different segments:

- Starter formulae for the age of 0 to 6 months
- Follow-up formulae for the age of 5 to 12 months
- Formulae for the age of 1 to 3 years
- Formulae for prematurely born
- Formulae for babies with metabolic disorders

The formulae is composed in different ways in order to best suit the growing baby.

Typical composition

Illustration of the composition of different formulae:

<table>
<thead>
<tr>
<th></th>
<th>Starter formula</th>
<th>Follow up formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>24 %</td>
<td>20 %</td>
</tr>
<tr>
<td>Protein</td>
<td>11 %</td>
<td>11 %</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>50 %</td>
<td>56 %</td>
</tr>
</tbody>
</table>

EC-directive

According to the EC directive 2006/141/EC fats for use in both starter and follow-up formulas have to comply with the following points:

- Fat content of reconstituted product between 1.05 and 1.4 g/100 kJ
- For allergenic reason the use of sesame and cottonseed oil is not allowed
- The sum of Lauric acid (C12) and Myristic acid (C14): maximum 20 %
- Content of $\alpha$-linolenic acid: minimal 12 mg/100kJ
- Linoleic acid: between 70-285 mg/100 kJ
- Ratio between linoleic and $\alpha$-linolenic: minimal 5 and maximal 15
- Trans fatty acids: maximum 3 % of total fat content
- Erucic acid: maximum 1 % of total fat content
- Addition of LC PUFA is allowed. $\omega$-3: maximum 1 % of total fat content. $\omega$-6: maximum 2 % of total fat content (in case of AA: maximum 1 % of total fat content). Additional limitation: amount of EPA should not exceed that of DHA. The DHA content shall not exceed that of AA.
<table>
<thead>
<tr>
<th>Fatty acid composition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAPROIC</strong></td>
</tr>
<tr>
<td>CARBON ATOMS: DOUBLE BONDS</td>
</tr>
<tr>
<td><strong>Liquid oils</strong></td>
</tr>
<tr>
<td>Soyabean oil</td>
</tr>
<tr>
<td>Sunflower oil</td>
</tr>
<tr>
<td>Sunflower oil (high oleic)</td>
</tr>
<tr>
<td>Rapeseed oil (low erucic)</td>
</tr>
<tr>
<td>Maize oil</td>
</tr>
<tr>
<td>Olive oil</td>
</tr>
<tr>
<td>Flax seed oil (linseed oil)</td>
</tr>
<tr>
<td><strong>Palm oils</strong></td>
</tr>
<tr>
<td>Palm oil</td>
</tr>
<tr>
<td>Palm olein</td>
</tr>
<tr>
<td>Palm stearin</td>
</tr>
<tr>
<td><strong>Lauric oils</strong></td>
</tr>
<tr>
<td>Palmkernel oil</td>
</tr>
<tr>
<td>Coconut oil</td>
</tr>
<tr>
<td><strong>Other oils</strong></td>
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<tr>
<td>Cow Milk Fat</td>
</tr>
<tr>
<td>Human milk fat</td>
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<tr>
<td><strong>AAK typical products</strong></td>
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<tr>
<td>InFat™ 1940</td>
</tr>
<tr>
<td>Akonino NS</td>
</tr>
<tr>
<td>Akonino NR</td>
</tr>
</tbody>
</table>
AAK – Wherever you are

The first choice for value-added vegetable oil solutions

AAK is the world’s leading manufacturer of high value-added speciality vegetable oils and fats. The many advantages of these natural and renewable raw materials create opportunities for you in the market segments of confectionery, food, infant nutrition and beauty and personal care.

The advantage of our product portfolio is that it consists of natural or modified vegetable oils and fats that have a low saturated fat content and contain desired properties that promote healthier lifestyles.

But we don’t just sell products, we offer total value-added solutions. These are comprehensive packages of benefits like new product development, customization, market advice, delivery systems, technical support and AAK ACADEMY™.

Our head office is in Malmö, Sweden, and we have production facilities in Denmark, Mexico, the Netherlands, Great Britain, Sweden, Uruguay and USA. So no matter where you are in the world, you’re within reach of AAK, the first choice for value-added vegetable oil solutions.

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