Dr. Roland Adelmann

Fat for Life

Oils and fats in animal nutrition

Headquarters in Hamburg

Technology Centre in Ahrensburg

Berg + Schmidt: feed energy from the fields

For over 50 years, Berg + Schmidt has been one of the feed industry's leading suppliers of essential vegetable substances for healthy and profitable animal production. We concentrate on three important business fields: lipids (in particular fat powders and conjugated linoleic acids), enzymes and lecithin.

Our company is a member of the Stern-Wywiol Gruppe, an enterprise specializing in functional active ingredients for food and animal nutrition. With 11 specialist firms, 13 representative offices abroad and a large team of technologists and experts on the different industries we work national and international markets.

All our activities revolve around applications research at our Technology Centre in Ahrensburg, near Hamburg.

In the feed fat sector the focus is on palm fats and the numerous ways of processing and modifying them. We have had a decisive influence on the worldwide development of fat powders – bypass fats and highly digestible energy sources for monogastric animals. Our **BergaFat** brand has become synonymous with pure, quality fat in powder form, without a carrier.

As we see it, lipids are not just sources of energy; they are valuable adjuvants for other feed ingredients:

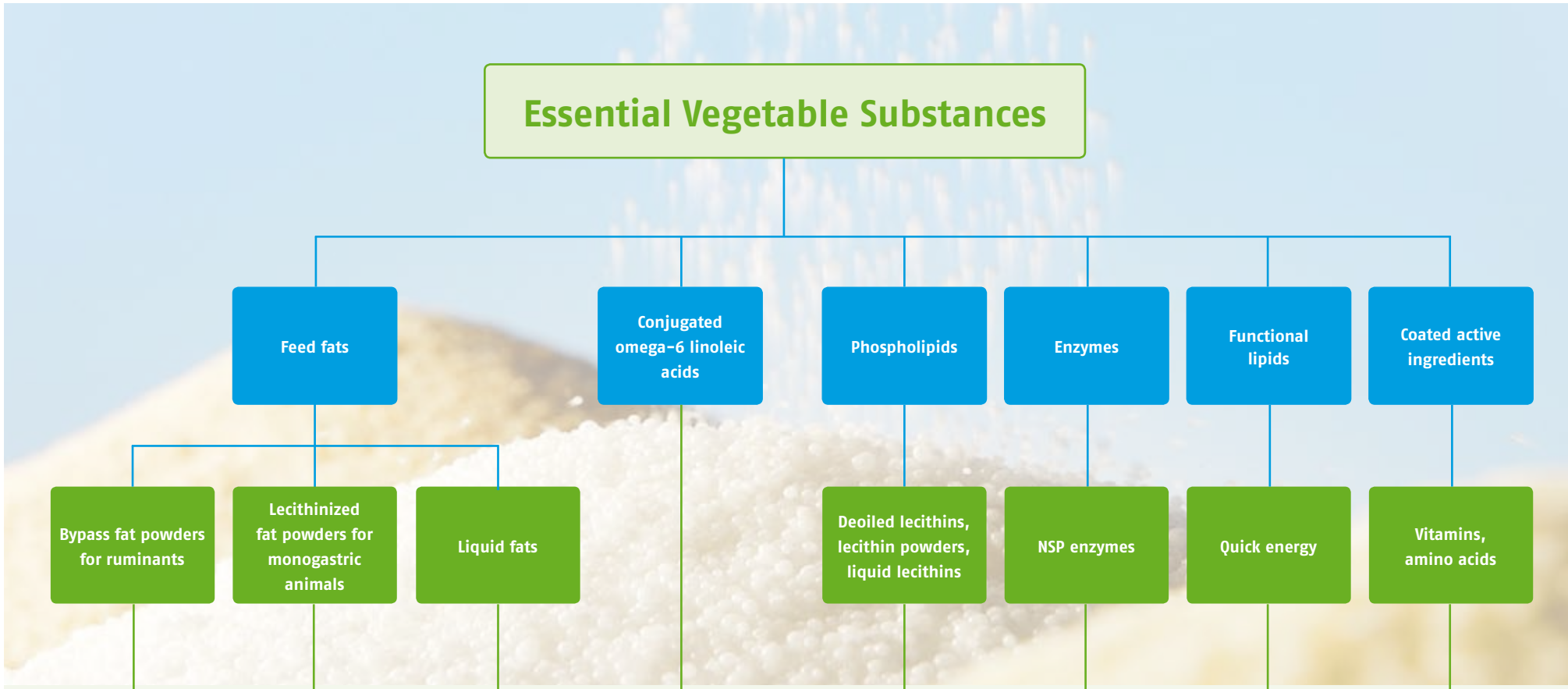
- We develop and manufacture special rumen bypass products
- We integrate selected components into a fat matrix in order to achieve better availability
- We fractionate and esterify fatty acids to make new fat compounds with highly specific nutritional properties
- We work continuously on the further development of vegetable oil and fat fractions to enhance the health and performance of all farm animals and boost profitability. The focus is on new technologies for transforming the oily phase of the fat into a crystalline powder.

All this results in customized solutions for greater profitability in animal nutrition.

Fatty-acid composition and typical data of natural fats and oils[1]

Fatty acids		Double bonds	Babassu	Coconut	Palm kernel	Palm	Palm, hardened	Palm, fractionated	Olive	Peanut	Rapeseed		Maize	Sunflower	Soybean	Cottonseed	Linseed	Castor	Butter	Pork fat	Beef tallow	Fish	Molecular weight	Acid value	Titre, °C
Butyric	C4:0																		3						-6
Caproic	C6:0				1														2				116	483	-4
Caprylic	C8:0		6	8	4														1				144	389	16
Capric	C10:0		4	6	4														3				172	326	30
Lauric	C12:0		48	47	47														3				200	280	45
Myristic	C14:0		18	18	16	1	1	1											10	2	3	7	228	228	53
Myristoleic	C14:1	1																	2		1		226	248	
Palmitic	C16:0		8	9	9	45	45	68	12	10	5		10	7	10	25	7	2	26	27	26	15	256	219	62
Palmitoleic	C16:1	1							2		1		1	1		1			3	4	4	6	254	221	-0.5
Stearic	C18:0		5	3	3	8	43	10	3	4	2		3	5	4	3	4	2	12	14	20	2	284	197	69
Oleic	C18:1	1	14	7	15	38	5	14	74	59	56		33	24	21	18	18	7	25	43	40	13	282	198	14
Ricinoleic	C18:1[2]	1																87					298	187	17
Linoleic	C18:2	2		3	3	10	1	2	10	20	21		52	63	56	52	14	4	2	9	5	2	280	200	-5
Linolenic	C18:3	3	4			1			1	1	10		1	1	8	1	58					2	278	201	-11
Stearidonic	C18:4	4																				4	276		
Arachidic	C20:0									2	1		1	1	1	1			2	1	1		312	179	75
Gadoleic	C20:1	1								2	2		1									9	310	180	24
Arachidonic	C20:4	4																	1	1			304	185	-49
Behenic	C22:0									3													340	164	80
Erucic	C22:1	1								2	4											15	338	165	30
EPA	C20:5	5																				9	302		-53
DHA	C22:6	6																				11	328		-44
Lignocerin	C24:0									2													368	152	79
Iodine value			10–18	6–11	13–23	50–55	8–12	10–18	75–94	80–106	110–126		103–128	110–134	120–143	99–119	169–196	82–90	25–38						
Saponification value			245–256	248–265	230–254	190–209	198–208		187–196	187–198	188–193		187–195	188–194	189–193	189–198	188–196		218–235						
Melting point			22 to 26	20 to 28	25 to 30	30 to 37	51 to 54	56 to 60	-9 to 0	-2 to 0	< 0		9 to 12	16 to -18	8 to -18	0 to 4	-18 to -27	-12 to -18	28 to 38	28 to 40	40 to 50				

[1]After Bockisch, 1993; B*S; Sigma-Aldrich, [2]Hydroxy


Essential Vegetable Substances
Feed fats
Conjugated omega-6 linoleic acids
Phospholipids
Enzymes
Functional lipids
Coated active ingredients
Bypass fat powders for ruminants
Lecithinized fat powders for monogastric animals
Liquid fats
Deoiled lecithins, lecithin powders, liquid lecithins
NSP enzymes
Quick energy
Vitamins, amino acids
• BergaFat F-100
• BergaFat F-100 HP
• BergaFat T-300
• BergaFat HTL-306
• BergaFat HTL-316
• BergaFat HPL-106
• BergaFat CP0
• BergaFat KP
• LodeStar CLA-1
• LodeStar CLA L50
• LodeStar CLA LP
• LodeStar CLAME-P20
• BergaPur
• BergaFit 60
• BergaThin
• BergaDust
• BergaZym P
• LipoVital C-92
• BergaPrime
• BergaMin Met
• LipoVital E-30

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Oils and fats in animal nutrition

Foreword

Many of our customers have expressed the wish to know more about oils and fats in animal nutrition. That has prompted me to write a brief overview of the subject and present it in a handy form. The overview is not meant to be a textbook, nor does it claim to be complete, but we do intend to update and enlarge it over the course of time. And for that we would welcome your contributions and suggestions for improvements.

Dr. Roland Adelmann, head of Research and Development at Berg + Schmidt GmbH & Co. KG

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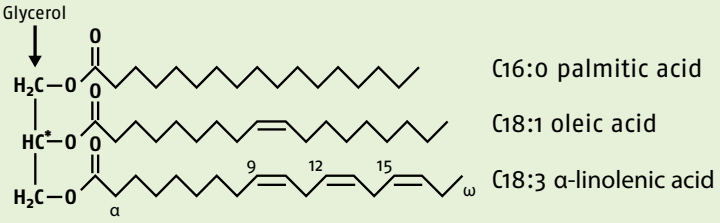
Oils and fats

Oils and fats are among the most important constituents of feed, since they supply essential fatty acids and other components as well as energy. Fats are also involved in the construction of body cells and in various hormones such as prostaglandins.

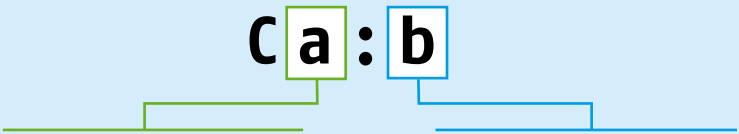
1.1 The chemical structure of fats

All fat molecules consist of a basic framework of glycerol to which up to three saturated or/and unsaturated fatty acids are attached (Figure 1). The degree of saturation and the chain length of these fatty acids determine whether a fat is solid or liquid at room temperature.

Fig. 1: Example of the chemical structure of native fats/oils

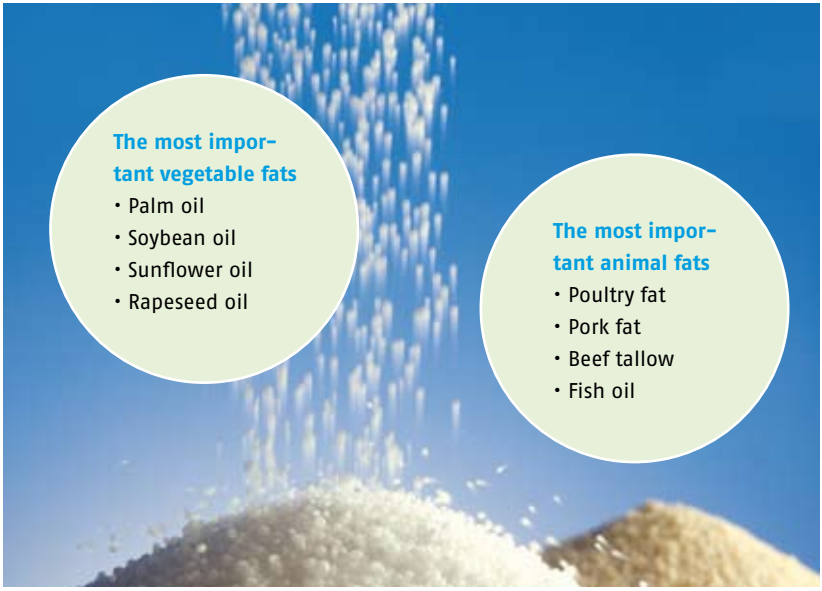


A fatty acid can be defined by the following simplified formula:



Oleic acid, for example, is expressed as C18:1; it contains 18 C atoms and 1 double bond.

1.2 Overview of the fatty-acid composition of the most important fats



Vegetable and animal fats mainly contain fatty acids with chain lengths from 14 to 18 carbon atoms; animal fats also contain the fatty acid C16:1, palmitoleic acid, which is very rarely found in vegetable oils. It is typical of the composition of most animal fats that the percentage of oleic acid, C18:1, is the largest, with palmitic acid in second place (Table 1).

Tab. 1: Fatty-acid composition of vegetable and animal fats (%)

		C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3
Oil plants	Palm oil	1	45	–	8	38	10	1
	Soybean oil	–	10	–	4	21	56	8
	Sunflower oil	–	7	–	5	24	63	1
	Rapeseed oil	–	5	–	2	56	21	10
Land animals	Poultry fat	1	22	2	7	57	15	6
	Pork fat	2	27	4	14	43	9	1
	Beef tallow	3	26	4	20	40	5	1

In the case of the fats from oil plants there are exceptions, namely coconut and palm kernel fat. Their fats consist largely of the medium-chain fatty acids C8:0 to C14:0, while their percentage of long-chain fatty acids with 18 carbon atoms is lower than in the other vegetable oils.

Tab. 2: Fatty-acid composition of coconut and palm kernel fat (%)

	C8:0	C10:0	C12:0	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2
Coconut	8	6	47	18	9	–	3	7	3
Palm kernel	4	4	47	16	9	–	3	15	3

Where animal fats are concerned a distinction has to be made between fats from land animals and those from marine animals. Land animals produce fats in which fatty acids with chain lengths between 14 and 18 carbon atoms predominate. Fats from marine animals, on the other hand, also contain considerable amounts of unsaturated fatty acids with 20 or 22 carbon atoms (Table 3).

Tab. 3: Fatty-acid composition of the fat from marine animals (%)

	C14:0	C16:0	C16:1	C18:1	C20:1	C20:4	C20:5	C22:5	C22:6
Herring	3	11	6	21	12	13	6	18	5

Palm oil plantation in Malaysia

Palm fruits

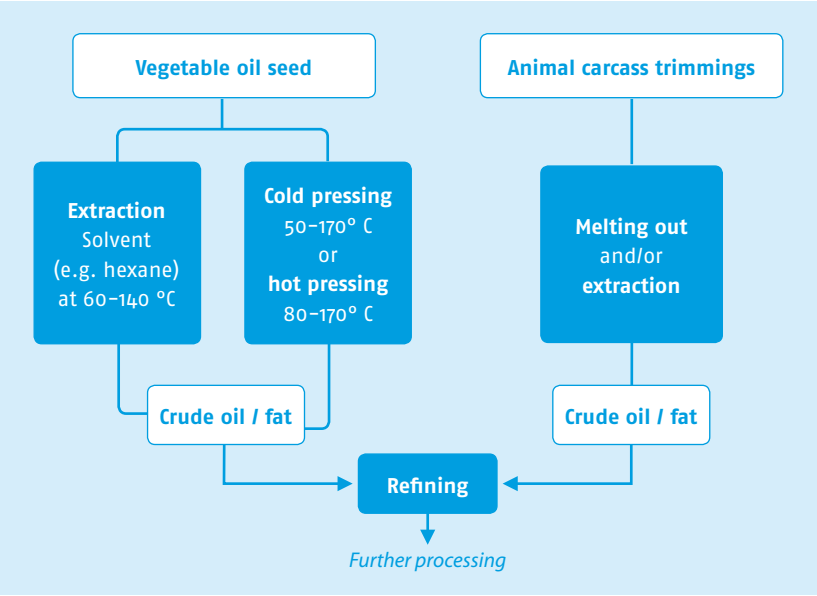
1.3 Production of fats and fatty acids

Vegetable fats are obtained by pressing the oil seeds or by extraction. Animal fats are produced by melting the fatty carcass trimmings, or in some cases by extraction or a combination of the two processes.

If the starting materials are fresh, the fats thus obtained do not consist of free fatty acids but of complete fat molecules. But if the starting materials used have already started to decompose, the fats produced contain a percentage of free fatty acids as well as complete fat molecules. These free fatty acids are undesirable in foods, and they are removed by refining; this results in two types of fat: one from intact fat molecules, and one that consists of free fatty acids only.

However, the splitting of fat molecules into glycerol and fatty acids can be done deliberately in order to obtain pure fatty-acid fractions with desired special properties.

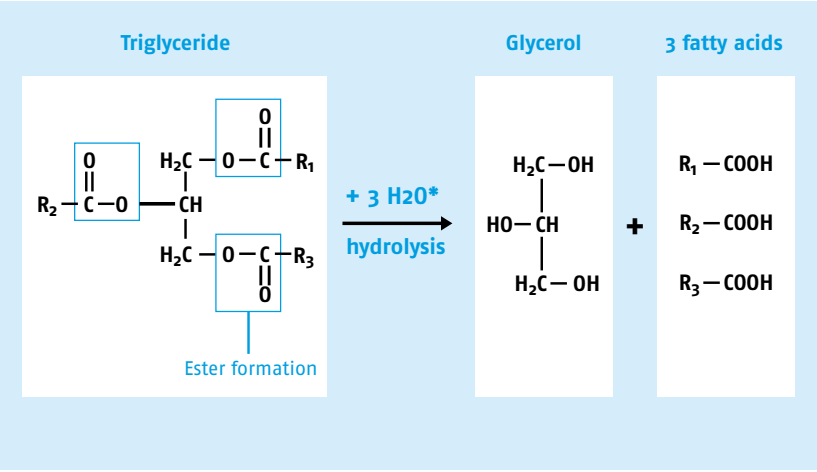
Fig. 2: Production of crude oil



1.4 The difference between triglycerides and fatty acids

In animal nutrition, the individual free fatty acids are regarded as fats as well as the complete fat molecules. A complete fat molecule is made up of one glycerol molecule and three fatty acids. This type of molecule is termed a triglyceride. When the fat molecules are broken down the different fatty acids are split off, so that finally one glycerol molecule and three single fatty acids remain from the original fat molecule. These fatty acids are used in animal nutrition too. From the point of view of energy, triglycerides and fatty acids are similar. The difference is that a triglyceride contains about 10% glycerol. Since glycerol is an alcohol, these 10% contain only about half as much gross energy as a fatty acid. The gross energy content of triglycerides is therefore only around 95% of the energy content of pure fatty acids.

Fig. 3: Difference between triglycerides and fatty acids



** At R1=R2=R3: pure triglyceride (exceptions in nature)*