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Demands on a "Positive List" of feedstuffs from the point of view of animal nutrition

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Introduction

The world's population is still growing. Apart from the environmental problems accompanying this growth, many people are asking how the world will cope with the nutritional needs of this increased population. Therefore, food security as the state of being secure in the ability to meet one's nutritional needs, or as freedom from hunger and malnutrition is one of the main focuses of the fundamental and applied sciences. After the Second World War food security was the main aim of policy and research in Germany and Europe (Figure 1).

Later the wishes of consumers changed, and apart from food security, many questions have been raised on food safety (Figure 1). Policy makers and scientists react to the questions of consumers.

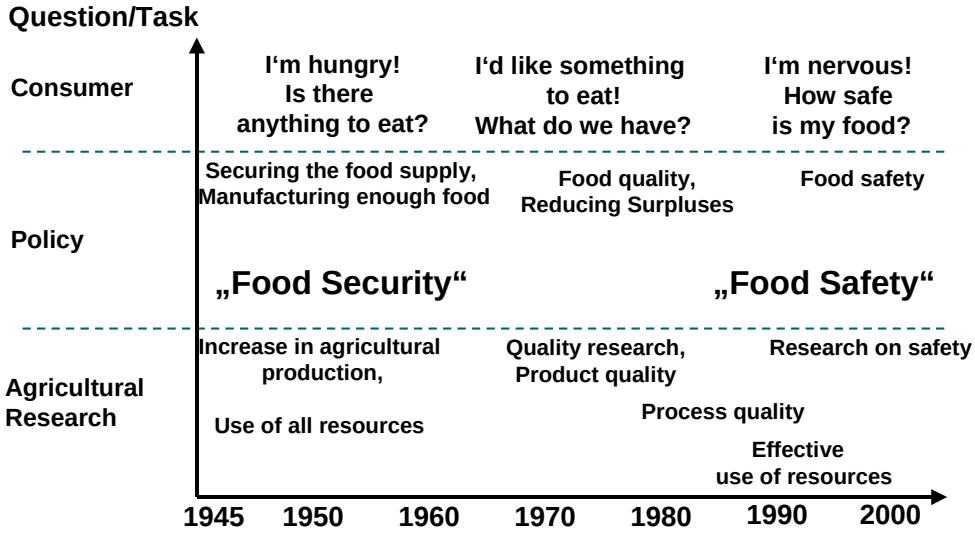

Figure 1: The main questions related to food as well as tasks for policy and agricultural research since the Second World War in Europe (FLACHOWSKY 2003)

Food security and food safety are two sides of the same medal (FLACHOWSKY 2003). The challenge of animal nutritionists is to contribute to the production of enough and safe food. The objective of the paper is to formulate the demands and wishes of animal nutritionists on a "Positive List" to ensure adequate supplies of safe food and to provide conclusions as a basis for research in feed sciences and animal nutrition.

Objectives of animal nutrition

The objectives of animal nutrition can be summarized as the **production of safe and valuable food of animal origin (and raw materials for industrial processing) with healthy animals and low input of limited resources under consideration of ecological and economical aspects**.

Apart from feedstuffs some further aspects influence the objectives of animal feeding and research in animal nutrition (Figure 2).

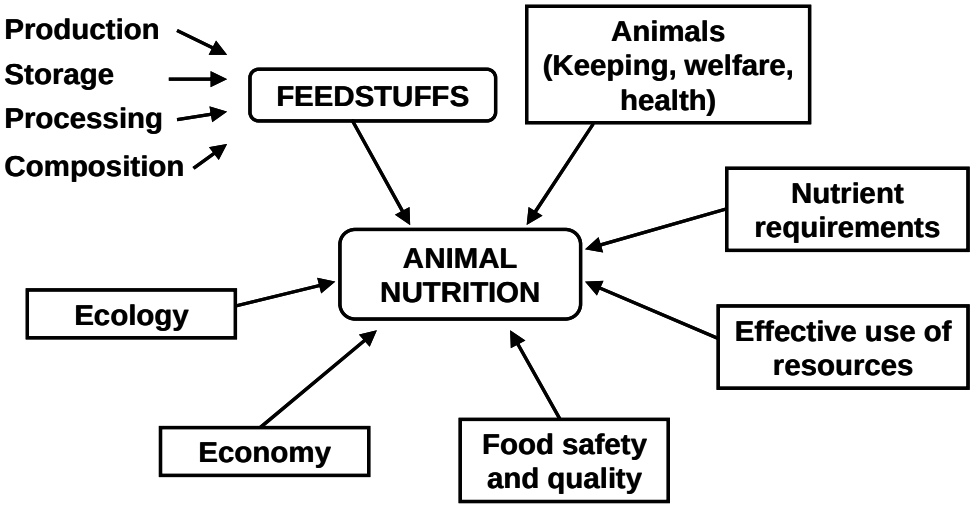

Figure 2: Important influencing factors on research in animal nutrition

Safety along the "Food Chain"

Food safety research means to minimize the contamination of food with undesirable substances along the entire food chain soil-plants-animals-humans (safety from the fork to the table, Figure 3).

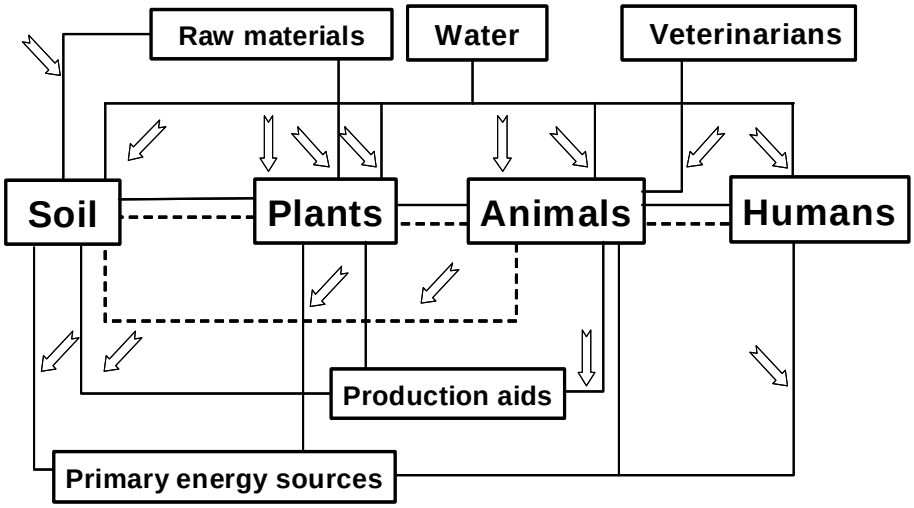

Figure 3: Important links in the food chain and selected contributions of the FAL (⇓) to "Food Safety"

Safety research in this field means identifying undesirable substances, assessing their risk potential, and contributing to their elimination or to blocking the sources, if necessary and possible. Some details are demonstrated on the basis of maize production and its use in the food chain in Figure 4.

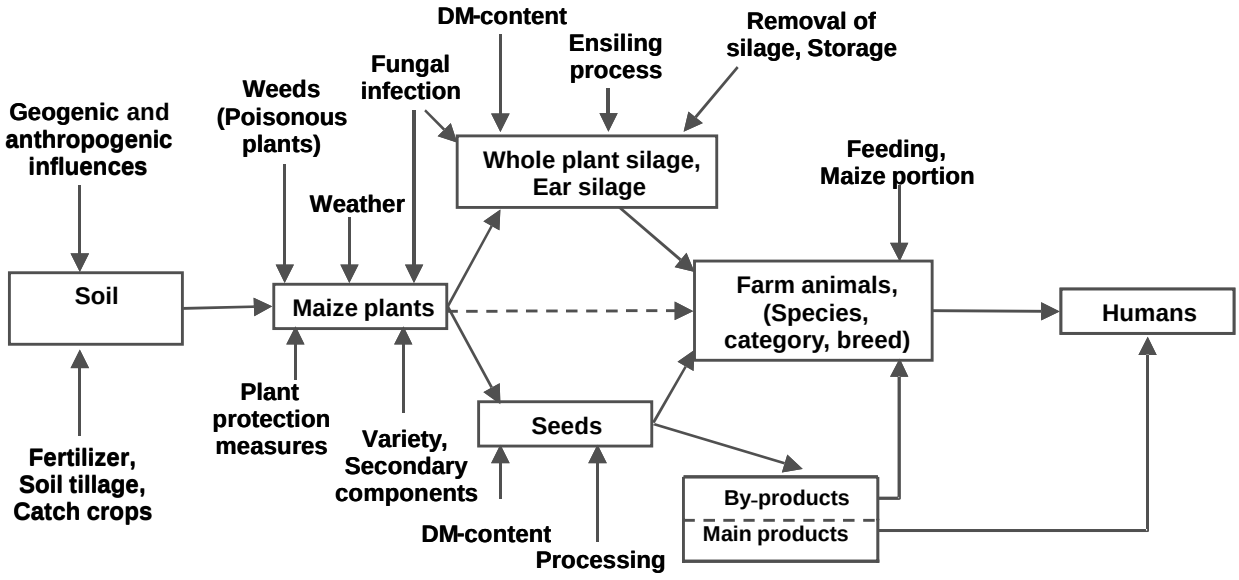

Figure 4: Maize in the food chain and selected influencing factors on product safety

Knowledge on feedstuffs

Many textbooks exist on feedstuffs and feed value tables on national and international level (e.g. Becker and Nehring 1965, DLG 1997, Jeroch et al. 1993, Kling and Wöhlbier 1977, Nehring et al. 1969, NRC 2002).

From the point of view of animal nutrition and food safety the following information on feedstuffs should be given in textbooks and feed value tables:

- Information on <u>nutritive value (desirable substances)</u>
  - Dry matter
  - Chemical composition (crude nutrients, fibre fractions, starch, sugar, amino acids, fatty acids, major and trace elements, vitamins etc.)
  - Energy (digestible, metabolizable and/or not energy)
  - Physical properties
- Information on <u>undesirable substances</u>
  - Natural origin (soil, microbes, fungi, poisonous plants, secondary plant constituents etc.)
  - Anthropogenic origin (production aids, environmental contaminants etc.)

Apart from the averages (mean values) of the nutritional constituents and undesirable substances for a given feedstuff information should be provided on:

- number of samples

- median
- standard error
- variation range (min. and max. values)

Demands on the "Positive List"

The "Positive List" of feedstuffs cannot replace textbooks and feed value tables. It should characterize the feedstuffs and, in addition, it should describe the way of production/processing and specific properties of feeds with data sheets. The following demands on the "Positive List" (incl. Data Sheets) of feedstuffs may be formulated from the perspective of animal nutrition and food safety:

- Clear description of different feedstuffs (incl. international name)
- Information on the most important desirable and undesirable substances
- Clear distinguishing features (e.g. fibre, fat, ash)
- Information on processing (incl. technical aids)
- Influence of processing on composition
- Limitations of using in animal nutrition
- Information on national specifications (clear labeling)
- Assigning numbers to feedstuffs (EU-System)

Challenges in feed science

Feed science research has been neglected during the past years. The establishment and improvement of the "Positive List" may challenge to more research in feed science. Such challenges are:

- Improving the knowledge' of <u>desirable substances</u>
  - Influence of plant breeding and cultivation on chemical composition
  - Influence of processing/conservation (feeds, food) under consideration of new processing technologies
- Improving the knowledge of <u>undesirable substances</u>
  - Content of further relevant substances
  - Possibilities to reduce/avoid the content (plant breeding, cultivation, processing, detoxification, further technologies of use, see Table 1)
- Improving the knowledge on
  - Bioavailability of desirable substances (see Figure 5)
  - Carry over of undesirable substances (see Tables 2 and 3)
- Life cycle studies (input/output) of food production (see Tables 4 and 5).

Plant breeding including genetic modification of plants and changed technologies of processing of feeds may influence chemical composition and nutritional value. Therefore investigations to desirable and undesirable substances are necessary.

For example cereals have been separated in various streams. Cereal dusts are much more highly contaminated with some mycotoxins or production aids as cleaned cereals or bran (Table 1). Therefore a removal of such dusts during processing may contribute to lower contents of undesirable substances in feeds and food.

Table 1: Average content of Deoxynivalenol (DON), Zearalenone (ZON) and Chlormequate (CCC) in "by-products" (dust), cereals and cereal bran (n = 365; UEBERSCHÄR et al. 2002)

	Cereal dusts (by-products)	Cereal	Cereal bran
DON (mg/kg)	1.8	0.19	0.25
ZON (µg/kg)	96	5	8
CCC (mg/kg)	0.85	0.37	0.66

Another topic of interest for nutritionists is knowledge on the bioavailability of desirable and undesirable substances in various animal species and categories. Figure 5 summarizes some properties of specific carbohydrates and feeds rich in these carbohydrates on different parameters in ruminants.

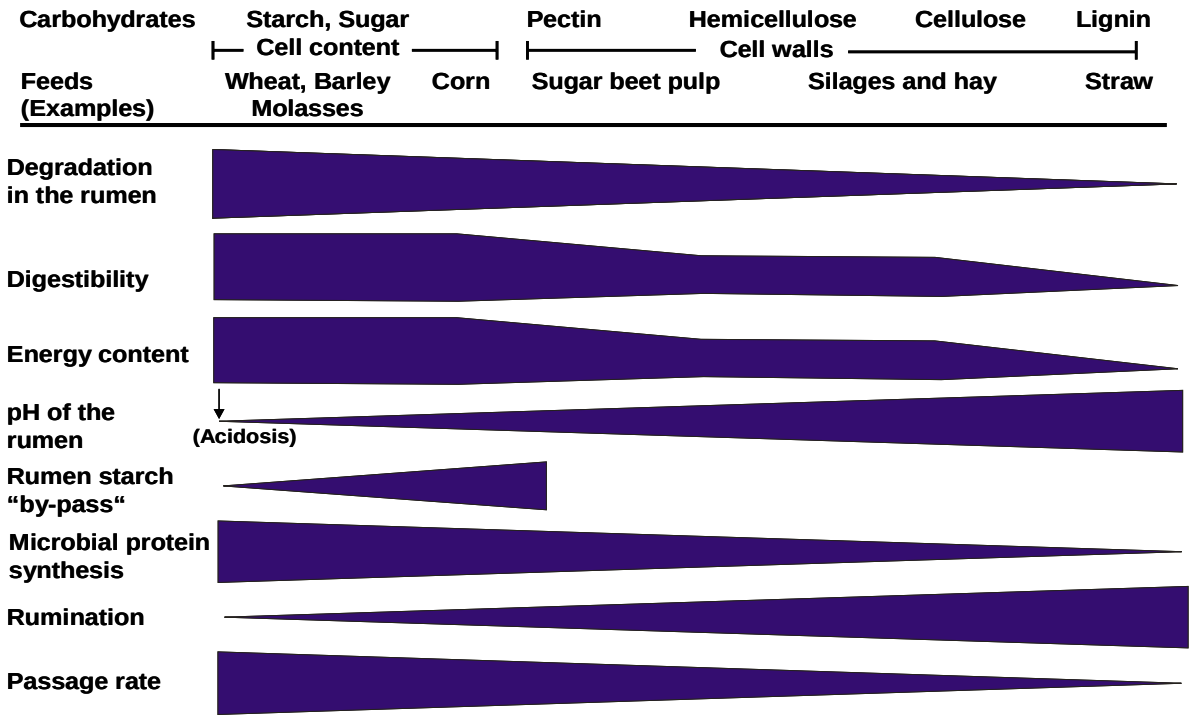

Figure 5: Properties of specific carbohydrates and feeds rich in these carbohydrates on different parameters in ruminants (LEBZIEN et al. 2003)

Tables 2 and 3 show carry over factors for dioxin- and furan-congeners from feed into milk according to various authors and for toxaphene congeners from feed into organs and tissues of broilers and layers.

Table 2: Carry over factors (congener milk : congener feed) of selected polychlorinated Dibenzo-p-dioxins (PCDD) and Dibenzofurans (PCDF) from grass and citrus pulp into milk (from SCAN 2000)

		Author							
Dioxin- or Furancongeneres		Malisch (2001)	Slob et al. (1995)	Mc Lachlan et al. (1990)	Schüler et al. (1997)				
Abrev.					Sept. 1995	May 1996	June 1996	Oct. 1996	$\bar{x}$
2.3.7.8-	TCDD	0.58	0.15	0.35	0.1	0.06	0.7	0.4	0.3
1.2.3.4.7.8-	HxCDD	nd	0.057	0.17	0.05	0.06	0.07	0.1	0.08
1.2.3.4.6.7.8-	HpCDD	nd	0.0062	0.03	nd	0.03	nd	0.01	0.02
2.3.7.8-	TCDF	0.028	0.0087	0.07	0.01	0.02	0.04	0.02	0.02
1.2.3.4.7.8-	HxCDF	0.33	0.043	0.19	0.05	0.01	0.1	0.04	0.07
1.2.3.4.6.7.8-	HpCDF	0.031	0.0039	0.03	0.004	0.01	0.02	0.01	0.01

Table 3: Carry over factors (congener tissue : congener feed) of selected toxaphene congeners from feed into different organs and tissues of broilers and laying hens (UEBERSCHÄR et al. 2001)

	Selected congeners			
	P44	P50	P58	P62
Broilers (5 weeks)				
Fat	12	29	12	17
Muscle	0.07	0.16	0.06	0.09
Liver	0.22	0.18	0.01	0.03
Kidney	0.11	0.21	0.03	0.1
Laying hens (38 weeks)				
Fat	16	17	15	11
Eggs	1.1	1.1	1.0	0.8
Muscle	0.4	0.4	0.33	0.25
Liver	2.9	1.5	0.14	0.37
Kidney	1.2	1.0	0.7	0.6

Data from Figure 5 and Tables 2 and 3 show high variations and demonstrate the necessity of more research in these fields to improve feed conversion, animal health and for better assessment of potential risks.

Life cycle studies may improve the knowledge on input of energy and limited resources and the output of gases (e.g. CO_2, CH_4, N-compounds) and other components along the food chain. There is a high variation in input and emissions between various feedstuffs (Table 4) and between various intensities of production (BOCKISCH et al. 2000).

Table 4: Input and emissions of various feeds (conventional production; BOCKISCH et al. 2000)

	Feedstuff				
	Wheat	Barley	Rape seed	Beans	Sugar beet
Primary energy (GJ/t)	2.4	2.5	6.0	2.1	0.4
Emission of climate relevant gases (kg CO_2-equivalents/t)	315	320	810	210	45

More research seems to be necessary to improve knowledge on life cycle along the food chain:

- Improvement of knowledge of input (energy, P, water etc.) in primary feed production,
- Evaluation of input (energy etc.) for by-products,
- Improvement of knowledge of input (energy etc.) of feed processing (conservation, storage, mixing, pelleting etc.) and transportation,
- Improvement of knowledge of input in food producing animals,
- Improvement of knowledge of output along the food chain (CO_2, CH_4, N_2O, NH_3 etc.).

Such information exceed the normal demands of a “Positive List”, but may also contribute to the acceptance and the use of such a list by feed producers and by farmers.

The establishment of a “Positive List” for feedstuffs is a big challenge for feed scientists and animal nutritionists.

Summary

- The safety and quality of foods of animal origin depend on safety and quality of feedstuffs.
- A “Positive List” of feedstuffs may contribute to food safety and quality.
- The “Positive List” of feedstuffs should inform on the content of desirable and undesirable substances, but must also describe the feeds, inform on processing and enumerate the feeds.
- Such a list may contribute to the safety of feed and food trade.
- The establishment of a “Positive List” is a great challenge for feed scientists and animal nutritionists. Their research may contribute to improving the quality of the list.

References:

BECKER, M., NEHRING, K. (1967): Handbuch der Futtermittel. Bd. 1-3, Paul Parey Verlag, Hamburg und Berlin

BOCKISCH, F.J., AHLGRIMM, H.-J., BÖHME, H., BRAMM, A., DÄMMGEN, U., FLACHOWSKY, G., HEINEMEYER, O., HÖPPNER, F., MURPHY, D.P.L., ROGASIK, J., RÖVER, M., SOHLER, S. (2000): Bewertung von Verfahren der ökologischen und konventionellen landwirtschaftlichen Produktion im Hinblick auf Energieeinsatz und bestimmte Schadgasemissionen. Landbauforschung Völkenrode, Sonderheft 211, 206 S.

DLG (1997): Futterwerttabellen, Wiederkäuer, 7 erw. Auflage, DLG-Verlag

FLACHOWSKY, G. (2003): Contributions of agriculture to improved food security and food safety. Fresenius Environm. Bull. **12**, 467-489.

JEROCH, H., FLACHOWSKY, G., WEISSBACH, F. (1993): Futtermittelkunde Gustav Fischer Verlag Jena und Stuttgart, 510 S.

KLING, M., WÖHLBIER, W. (1977): Handelsfuttermittel, Verlag Eugen Ulmer, Stuttgart

LEBZIEN, P., FLACHOWSKY, G., MEYER, U. (2003): Unveröffentl. Arbeiten des Institutes für Tierernährung der FAL

NEHRING, K., BEYER, M., HOFFMANN, B. (1969): Futtermitteltabellenwerk, Dt. Landwirtschaftsverlag Berlin

SCAN (2000): Opinion of the Scientific Committee on Animal Nutrition on the dioxin contamination of feedingstuffs and its contribution to the contamination of food of animal origin. Question No. 110, Dec. 2000, Brussels

UEBERSCHÄR, K.-H., SCHWIND, K.-H., HECHT, H. (2001): Carry over experiments with poultry using toxaphene to establish maximum residue levels for feedstuffs. Proc.Soc.Nutr.Physiol. 10, 180

UEBERSCHÄR, K.-H., VALENTA, H., DÄNICKE, S. (2002): Untersuchungen von Nebenprodukten der Müllerei auf Deoxynivalenol, Zearalenon und Chlormequat. FAL-Jahresbericht 2002, 57.