SUNFLOWER FOR HUMAN CONSUMPTION, A QUESTION OF PROTEIN QUALITY

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The production of vegetable products requires a lower use of scarce resources than the production of animal products. Therefore vegetable products have a higher yield per hectar than animal products and several protein-enriched cereal foods are now used in developing countries.

One of the activities attached to the Ethiopian Nutrition Institute in Addis Ababa is the production of FAFFA, a protein-rich weaning food for children. At the moment this mixture contains 57 per cent wheat, 10 per cent chick peas, 18 per cent defatted soy flour, 5 per cent dried skim milk, 8 per cent sugar, and 2 per cent salt. It would be desirable to base the FAFFA production entirely on Ethiopian raw material. Because of this, much work has been carried out in order to prepare protein concentrates from suitable Ethiopian oil seeds. The biological and toxicological properties of protein concentrates obtained by water extraction from niger seed (nug, Guizotia abyssinica Cass.) have been reported by Eklund (1971). Likewise the biological properties of a protein concentrate prepared from sunflower seeds (Helianthus annuus L.) by extraction with diethylether has been tested in preclinical and clinical experiments, Ågren et al (1968) and Andersson et al (1969). Among other mixtures, a mixture of 49 per cents cereals, 25 per cents peas, and 15 per cent sunflower concentrate was tested with rather good result, when 1 per cent lysine was added to the sunflower concentrate.

A modified extraction method has been used to produce a lipoprotein concentrate from husked sunflower seeds. The concentrate tested had 48 per cent protein, 22 per cent fat, and a calorie value of 430 kcal/100 g. Lysine is the first limiting amino acid, and as the available lysine was 90 per cent of the total lysine, the protein score was 51. The protein efficiency ratio (PER) was 2.2 and the productive protein value (PPV) 55. By adding lysine it was possible to reach 3.3 - 3.4 for PER and 58 - 60 for PPV, which is the same as found for casein, Eklund et al (1971).

To study the quantitative and qualitative differences in protein content between different sunflower strains twenty-one different sunflower varieties from all over the world were cultivated one year on the same farm in Ethiopia and then analysed. Analyses were also carried out on eight samples cultivated in different parts of the world.

The oil content of husked and dried samples was determined by Soxhlet-extraction with diethylether, the extraction repeated three times. Total nitrogen content (N) was analysed by micro-Kjeldahl method. Basic amino acid analyses were performed according to the method of Spackman et al (1958). To estimate the protein quantity and quality dye-binding capacity (DBC) was used, giving the

amount of Acilane Orange G bound per g N, Mossberg (1969).

The amount of husk varied from 27 to 48 per cent, and the weight of 1000 seeds from 27 to 48 g. The nitrogen content of kernels without husk varied from 3.7 to 6.1 per cent of dry matter and the oil content from 48.2 to 66.8 per cent. The data for oil, N, DBC, lysine, histidine, and arginine are given in Table 1.

Table 1 - Quality of sunflower samples

Origine	Kernel without husk		mg/g N			
	Oil (DM %)	Nitrogen (DM%)	DBC	LYS	HIS	ARG
Material grown in Ethiopia						
Strain, seed from						
Kenya White, Kenya	57.7	4.76	2456	249	178	659
Russian Black, Ethiopia	55.1	5.01	2256	242	171	628
Kustanajskij 91, USSR	48.2	6.07	2200	207	160	644
Saratovskij 169, USSR	55.9	5.13	2306	225	166	654
Heza Bako, Ethiopia	55.2	5.09	2238	228	167	651
5.4 Tapiozele, Hungaria	49.1	5.12	2506	255	163	604
Yugoslavia Grey, Yugoslavia	54.8	5.13	2150	228	166	635
From Alemaya, Ethiopia	57.8	4.72	2444	234	171	655
Szabolesi, Kosice, CSR	54.7	5.28	2406	234	162	636
Barnaulskij 1501, USSR	60.3	4.70	2444	209	159	652
VNIIMK 1646, USSR	58.8	4.67	2475	221	170	625
No 4 from Alemaya, Ethiopia	56.9	4.94	2569	223	163	610
Idanov 8281, Rumania	58.9	4.80	2275	217	168	640
Hezera Improved, FAO	60.2	4.74	2256	224	172	626
Kenya Grey Striped, Kenya	55.1	5.15	2475	221	169	621
Fuksinka 10, Rumania	57.9	4.76	2444	225	169	638
Porlo, Portugal	57.2	5.00	2256	233	174	636
Cernjanka 66, USSR	56.8	5.16	2225	220	160	625
Population 158, Germany	57.2	4.92	2238	206	147	560
Kenya Black, Kenya	60.0	4,65	2306	200	147	545
Irogi Naprraforgo, Hungaria	55.8	5.39	2325	197	150	587
Strain, grown in						
INRA 6501, France	66.8	3.68	2756	229	164	538
INRA 7702, France	62.5	4.56	2550	203	158	577
Unknown, Malawi	58.5	4.52	2781	238	176	602
Unknown, China	58.8	4.17	2931	248	177	583
Unknown, Tanzania	54.4	5.16	2688	209	160	573
Unknown, Malawi	51.2	5.39	2700	232	170	584
Unknown, Kenya	56.5	5.11	2713	223	170	605
Unknown, Hungaria	58.2	4.78	2700	226	174	609

The samples from the cultivation in Ethiopia have been statistically treated as one group because the variation in environment between these samples was at a minimum. Using the data from these samples the correlation between DBC on the one hand and lysine, basic amino acids and N respectively on the other was nonexistent showing a correlation coefficient of 0.29 for DBC/LYS, 0.16 for DBC/BAA and 0.18 for DCB/N. Studying nitrogen conditions in safflower McCready et al (1970) also did not find the DBC method satisfactory as a rapid quality control. On the other hand in studies of other solvent extracted materials, as fish meal DBC gives a very good result on the amount of available lysine, Bunyan & Woodham (1964).

In Table 2 the correlation studies of lysine, arginine, and histidine to N in dry matter and to N in extracted matter are summed up showing a strong correlation between the basic amino acids and N in dry matter of husked kernels. The correlation between lysine content and nitrogen expressed in dry matter is illustrated in Figure 1, which is in agreement with the data presented by Baudet et al (1971). On the other hand from a nutritional point of view the interesting fraction is that remaining after extraction and here no correlation was found between lysine and N in the extracted fraction as can be seen from the data in Table 2. This means that protein-rich strains have a higher deficit in lysine than those containing less protein. The analyses showed however a good correlation between arginine and N in the extracted fraction.

Table 2 - The correlation between basic amino acids and nitrogen content in 21 samples of sunflower cultivated in Ethiopia.

Amino acid/N in dry matter of husked kernels		r
Lysine	L = 0.178 x N + 0.227 ± 0.076	0.62
Arginine	A = 0.670 x N + 0.222 ± 0.150	0.83
Histidine	H = 0.133 x N + 0.158 ± 0.041	0.73
Amino acid/N in dry matter of extracted kernels		
Lysine		- 0.03
Arginine	A = 0.622 x N + 0.035 ± 0.322	0.61
Histidine		0.45

Further studies are proceeding to determine the variation in available lysine between the samples and further material will be tested in the hope of finding sunflower varieties rich in lysine which could be used in a protein-rich weaning food.

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Figure 1 - Correlation between lysine content (g/100 g dry husked kernels) and nitrogen content (g/100 g dry husked kernels)