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Usage of decorticated sunflower meal in feed formulation

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Abstract
The article provides an overview of the nutritional aspects associated with the utilization of sunflower meal in poultry diets. Sunflower meal (SFM) has the potential to be a major feed ingredient for poultry in many countries not suitable for extensive soybean cultivation. However, it is well known that feed represents the main cost of animal and poultry production and accounts about 75% of the total cost. SFM is a good source of protein with amino acid availabilities similar to those of soyabean meal (SBM), and much higher than those in cottonseed or rapeseed meals. Poultry, especially layers have much use of sunflower meal as the sunflower meal is high in methionine, a necessary ingredient for layer hens absent in general feed products. Fibre content should be decreased to a minimum by dehulling during processing of the sunflower seed for oil extraction. Fibre < 12%) can still cause bulky feed at higher inclusion rates (< 30%), and as a result dietary nutrient dilution (particularly in broiler diets) may occur. Nevertheless, pelleting the diet can help overcome the bulkiness and thereby lead to improved growth and feed efficiency. Enzyme supplementation to SFM-based diets in different types of poultry species need further study.

Keywords: Sunflower, sunflower meal, dehulling, physical characteristics, sunflower kernels

Introduction
Sunflower seeds contain more than 45% of oil. The seeds are first subjected to decortication to obtain high protein meal. In one method only pre-pressing is carried out leaving 18 to 20% as residual oil in the pre-pressed cake. In the second method full pressing is carried out in screw presses leaving 10 to 12% residual oil in the fully pressed cake. For recovery of residual left over oil in the cake, the cake is subjected to solvent extraction process. The composition of sunflower meal varies with the quality of the original seed and the method of processing. In terms of production, it's the fourth most significant oil cake when soy flour, oilseed meal and oilseed meal. The standard of helianthus meal depends on the plant characteristics (seed composition, hulls/kernel quantitative relation, dehulling potential, growth and storage conditions) and on the process (dehulling, mechanical and/or solvent extraction). Decorticated sunflower cake is a digestible high protein feed that can be used freely for poultry.
In some countries, sunflower meal is already being used as a substitute for the more conventional protein sources, such as soybean meal. The lack of detailed information and, in many instances, the contradictory reports, on the nutritive value of sunflower meal have impeded its broad use as a feedstuff even in geographical areas where sunflower meal is produced cheaply and in substantial amounts. The variability in the chemical composition of sunflower meal contributes to most of the inconsistency in the reports on sunflower meal. The two most variable nutrients in the meal are crude protein and fiber, which vary in concentration from 23 to 59% and 8.2 to 31.6%, respectively (National Research Council,

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1984) [18]. The metabolizable energy as well as crude protein contents usually decrease as the level of dietary fiber increases in sunflower meal. Therefore, an accurate determination of the metabolizable energy content of sunflower meal is required prior to its use in poultry diets. This is especially important in broilers because of their limited ability to adjust their feed intake in response to the energy concentration of the diet. Intake of Supplemental fats could be used as concentrated sources of energy to Increase the MEn concentration of diets containing sunflower meal. Besides, their contribution to the MEn of the diet, supplemental fats exert an "extra caloric effect" by reducing the rate of passage of feed through the digestive tract and allowing more time for complete digestion and absorption of dietary nutrients. This could be especially important in diets containing sunflower meal, whereby the high fiber content may increase the rate of passage to an extent that optimum digestion and absorption are hindered.

Sunflower seed proteins

The protein content of the seed varies with the genotype from 9 to 24% (Jackson, 1956; Smith and Guard, 1958) [2, 17]. Selection for high oil content resulted in decreased protein content because protein and oil contents are negatively correlated. However, a redistribution of protein fractions has occurred during selection for high oil content, resulting In an Increase of the albumin fraction. Moreover, an Increase In the ratio of albumin (17-23%) to globulin (55-60%) Improved protein quality greatly since globulins have higher levels of phenylalanine and aspartic acid but lower concentrations of methionine, cystine and lysine than the albumin. Environmental factors can also affect protein content and quality. Protein content increased from 14 to 20% as environmental temperature Increased from 10 to 26 °C. Borodulina and Suprunova (1976) [4] Indicated that growing sunflower under dry land conditions tends to increase the salt-soluble fraction of protein and lower its quality. Under optimal processing and dehulling conditions, the protein quality of a meal from sunflower seed is equivalent to that of soybean meal. However, when processing conditions are harsh or when excess heat is used to desolventize the meal, some decline in biological value occurs due to the destruction of lysine, arginlne and tryptophan.

Sunflower hulls

The pericarp or hull is composed of approximately equal proportions of lignin, pentosans and cellulosic materials representing 82 to 86% of the total weight of the hull (Earle *et al*., 1968) [10]. The lignin and the hull carbohydrate are highly indigestible by animals. Hull content of sunflower seeds varies between 30—40% depending on the variety. Its hull mostly contains crude fibre and insignificant quantity of fat. It is usually removed before oil extraction otherwise its presenee would cause great wear on machinery with higher energy requirement as well as its presence in cake or meal would reduce their biological value. Moreover, the hull would reduce the total yield of oil by absorbing and retaining oil in the pressed cake, hence its removal is must.

Table 1: Nutrient content of solvent extracted sunflower oilcake based on amount of hulls retained

	Dehulled	Partially dehulled	No hulls removed
DM, %	90	90	90
CP, % DM	41	34	28
Fat	0,50	0,80	1,50
CF	14,00	21,00	24,00
Ash	5,90	5,90	6,20
Ca	0,34	0,35	0,36
P	1,30	0,95	0,97
K	1,07	1,07	1,07
Mg	0,79	0,79	0,80

Heslay (Ed.) National Sunflower Association, 1994

Processing Procedures of Sunflower Seeds

Processing conditions of sunflower seeds during oil extraction are critical for maximizing oil yield and in producing a good quality meal that can be used successfully in animal or human nutrition. Hence, processing conditions are optimized for this purpose but sometimes at the expense of the nutritive qualities of the meal. Sunflower seed may or may not be dehulled prior to extraction, depending primarily on the design of the processing plant. Dehulllng has many advantages; it reduces the movement of an unnecessary mass through the systems, it reduces wear in the expeller, it reduces the wax content of the oil, and it reduces the fiber content of the meal (Dorrell, 1976) [9]. The kernels are crushed or rolled, then cooked to facilitate the disruption of oil-bearing tissue (Macuk, 1971) [13]. The cooking temperature has been shown to affect the efficiency of oil extraction and nutritive value of the meal. The flaked kernels are prepressed in a screw press or expeller (Hill-Haas, 1976) [19]; then the oil is extracted using an organic solvent. The main solvent used is hexane, but other solvents can be used. Solvents are recovered by evaporation using heat. Morrison *et al*. (1953) [14] reported an increase in the oil content of sunflower meal when the cooking temperatures were decreased from 115 °C and 127 °C to 93 °C and 104 °C in the cooker and conditioner, respectively. Also, sunflower meal processed at lower temperatures (93-104 °C) supported better growth when fed to growing chickens.

Table 2: Chemical composition of sunflower meal

Composition	
Metabolizable energy (kcal/kg)*	1.81
Crude protein (%)	31.40
Calcium (%)	0.30
Total phosphorus (%)	1.00
Crude fiber (%)	23.00
Methionine (%)	0.72
Lysine (%)	1.22
Methionine + cystine (%)	1.25
Threonine (%)	1.19
*Rostago *et al*. (2005)	

Chemical Composition of Sunflower Meal

The chemical composition of sunflower seed meal compares favourably with most other vegetable-type meal. The main exceptions are the higher fiber and ash contents, which tend to reduce the metabolizable energy of the meal. Composition of the meal tends to vary directly with the efficiency of the dehulllng and extraction procedures. Dehulling is usually biased towards minimum loss of oil-bearing tissue; therefore, the meal contains more fiber than desired for optimum quality (Dorrell, 1976) [9]. The sunflower meal protein has a well-balanced amino acid composition. Sunflower meal Is known to be a good source of calcium, phosphorus and B-complex vitamins (Morrison, 1975) [15]. Sunflower meal is free of toxic compounds that may seriously impede its use in human or animal nutrition.This article focused on assessments of the productive effects generated by the usage of the decorticated sunflower seeds in the poultry feed.

Table 3: Amino acid composition of the SBM, SFM, SSM and RSM (DM basis)

Item (%)	SBM	SFM	SSM	RSM	SEM
CP	98.13a	82.60d	84.95c	88.47b	1.80
Lys	91.56b	94.89a	73.92d	90.93b	2.47
Asp	86.07b	90.68a	77.96c	85.73b	1.42
Thr	89.04a	91.12a	90.16a	86.09b	0.63
Ser	86.19bc	84.18c	91.47a	88.03ab	1.04
Glu	79.12c	94.74a	94.17a	89.03b	1.91
Gly	52.81a	36.01a	58.97a	21.85c	4.48
Ala	93.95bc	95.03ab	96.74a	74.24d	2.77
Cys	73.47b	14.51d	67.30c	98.74a	9.27
Val	85.99bc	89.15a	53.15d	87.58ab	4.51
Met	94.78b	79.35c	98.58a	72.42d	3.28
Ile	89.67b	94.34a	94.36a	90.24b	0.71
Leu	90.88b	94.44b	95.17a	80.56c	1.78
Tyr	84.90b	73.35c	94.23a	73.78c	2.78
Phe	88.54bc	91.13ab	93.04a	85.40d	0.98
His	88.95b	92.24a	92.84a	74.23c	2.29
Arg	90.07c	94.97b	96.73a	91.14c	0.85
Pro	66.54b	72.31b	68.03b	78.37a	1.58
TAA	86.72b	86.49b	89.76a	83.92c	0.64
EAA	89.99b	92.67a	92.74a	86.68c	0.75
NEAA	82.86b	79.92c	86.94a	81.34b	0.82
BCAA	89.61c	93.17a	91.95b	86.16d	0.82

Material and Methods

The procedure for the collection of data was through in-depth interviews and discussions, information analysed was mainly based on the records available from the following sources----

1. Oil millers
2. Poultry farms
3. Brokers
4. Govt Department
5. Poultry Hatcheries
6. Directorate
7. Oilseed growers

Results and Discussion

Sunflower seeds from oil types contain about 20-30% hulls, which are often removed before oil extraction. This is because of their deleterious effects on oil presses: they hinder lower oil extraction and reduce the quality of both oil and meal (Kartika, 2005) [12]. Reducing the hull content by 1% improves pressing capacity by 2.5%. A well-managed dehulling process yields seeds with 8-12% hulls remaining on the kernels (Campbell, 1983) [6]. Dehulling is done after cleaning the seeds and drying them down to 5% moisture, which facilitates kernel-hull separation (Kartika, 2005) [12]. The usual process consists in cracking the seeds by the mechanical action of centrifugal or pneumatic shellers. It can also be done by abrasion (Carré, 2009) [8]. The resulting blend is winnowed to separate the hulls from the kernels. Some sunflower varieties have thinner hulls that are more difficult to remove. In this case, dehulling is not recommended as it may result in oil loss, and increases extraction costs without enhancing oil and sunflower meal quality (Grompone, 2005; Campbell, 1983) [11, 6].

Conclusion

Based on findings of the survey it can be reported that SFM can be a highly acceptable feed ingredient for poultry. SFM may provide a rich source of crude protein (32% at least), crude fiber, amino acids, energy, minerals, etc. in poultry rations. This article highlights that the chemical composition, amino acid profile, anti-nutritional factors and nutritive value of SFM and its use as a protein source with SBM in broiler and layer diets.Current recommended maximum dietary levels for SFM are 15-20% for broilers and layers and but the higher levels of SFM can be used successfully with appropriate diet formulation with adjustments for energy and amino acids particularly lysine and methionine. When formulating diets with SFM, digestible amino acids should be used especially for lysine, threonine and sulfur amino acids. Using high levels of SFM in poultry diets will change the amino acid profile, crude fiber and energy contents as well as the amounts of feedstuffs/ingredients being used. It can be concluded that sunflower meal can be used as an alternative protein source ingredient up to 26 % in layers diets and can replace 100 % of groundnut meal without hazard effects. Substitution of 50% groundnut meal or inclusion of 13% sunflower meal in layers diets resulted in the best performance of layers in terms of feed intake, body weight gain, egg number, egg mass, feed conversion ratio, laying, adding to that the highest profit.

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