International Journal of Science, Environment and Technology, Vol. 3, No 3, 2014, 827 – 835

ISSN 2278-3687 (O)

Review Article

CHEMICAL COMPOSITION OF SESAME OIL CAKE – REVIEW

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Abstract: Scientists are on the lookout for an alternate source of cheaper oil cake with low level of aflatoxin. One such alternate is the sesame oil cake which contains on an average 32% crude protein (CP), 8-10% oil and total oil and albuminoids of 40-42% and costing lower than soyabean meal and groundnut oil cake. It has been reported to be rich in essential amino acids namely methionine and cystine (Johri *et al*., 1988).

1. CHEMICAL COMPOSITION

1.1.1 Proximate Principles, Calcium and Phosphorus Contents

1.1.1.1 Sesame seed

The proximate composition, calcium and phosphorus contents of white and black varieties of whole and dehulled sesame seed and hulls are presented in Table 1. The crude protein content in dehulled seed varied between 21.10 to 21.50% which was marginally higher than whole seeds. There was a definite relative increase in the crude fat content in dehulled seeds (53.5 – 54.1%) compared to whole seeds (49.8 – 50.2%). But the crude fibre content was very low in dehulled seeds (1.3 – 1.4%) compared to whole seeds (3.2 – 3.3%). Similarly, the mineral matter in dehulled seed (2.3 – 2.6%) was comparatively lower than whole seed (4.8 – 5.2%), which was confirmed by a low calcium content in dehulled seeds (0.06 – 0.19%) compared to whole seeds, however there was no much changes in the phosphorus content of dehulled and whole seed.

*Received Apr 15, 2014 * Published June 2, 2014 * www.ijset.net*

Table 1: Percent proximate composition, calcium and phosphorus content of sesame seeds and hulls

Constituent	White variety			Black variety		
	Whole seed	Dehulled seed	Hull	Whole seed	Dehulled seed	Hull
Moisture	5.40	6.20	4.20	5.20	6.10	4.10
Fat	50.20	54.10	10.20	49.80	53.50	9.90
Protein	19.80	21.10	8.00	20.00	21.50	8.10
Crude fibre	3.20	1.40	18.50	3.30	1.30	19.50
Carbohydrates	14.90	14.70	22.00	14.70	14.90	15.90
Mineral matter	4.80	2.30	22.80	5.20	2.60	24.20
Calcium	1.06	0.19	9.75	1.21	0.06	12.10
Phosphorus	0.47	0.48	0.51	0.62	0.62	0.66

(Mehta, 2000)

1.1.1.2 Sesame oil cake

Proximate composition, calcium and phosphorus contents of sesame oil cakes are presented in Table 2. The crude protein content in ghani cake ranged from 35 to 39.10% which was lower when compared to solvent extraction cake (41 – 45%) and expeller cake (39.10 – 47.10%). Similarly, the crude fibre content in ghani cake ranged from 2.4 to 4.2%, which was also lower when compared to solvent extracted cake (7 – 7.2%) and expeller cake (4.7 – 9.97%). The ether extract value was lower in solvent extracted cake when compared to ghani cake (5.1 – 9.2%) and expeller cake (6.99 – 9.30%). But there was no much difference in the calcium and phosphorus contents of the three types of oil cakes.

1.1.2 Amino Acid Composition

1.1.2.1 Sesame seed

The amino acid composition (g/16 g N) of sesame seed is presented in Table 3. In general the amino acid composition of whole and dehulled seed except arginine (12.5 vs 9.5) and phenylalanine (4.35 vs 6.2) were almost similar. The lysine content in whole seed ranged from 2.5 to 3.0 while the methionine level was between 2.5 to 4.0.

1.1.2.2 Sesame oil cake

The amino acid composition (g/16 g N) of ghani, expeller and solvent extracted sesame oil cake are presented in Table 4. An overall picture reveals that the amino acid content of ghani cake was comparatively higher than expeller or solvent extracted cakes.

The lysine content in ghani cake was higher (2.90) when compared to the expeller (1.14 – 2.20) and solvent extracted cake (1.10). Similarly the methionine content in ghani cake (3.10) was higher than expeller cake (1.23 – 3.0) and solvent extracted cake (1.27).

1.1.3 Fatty Acid Composition of Sesame Oil

The per cent fatty acids composition of sesame oil are presented in Table 5. The saturated fatty acids in sesame oil ranged from 14 to 15%, while the unsaturated fatty acids ranged between 80 and 82%. The chief saturated fatty acids are palmitic acid (7 – 12%) and stearic acid (3.5 – 6%) while the predominant unsaturated fatty acids are oleic (35 – 50%) and linoleic acid (35.5 – 41.2%) (Mehta, 2000).

1.1.4 Mineral Composition

The mineral composition of expeller sesame oil cake was reported to be 1.29% potassium, 0.8% magnesium, 107.5 ppm zinc, 51.61 ppm of manganese and 100 ppm of iron (N.R.C. 1994).

1.1.5 Vitamin Composition

The expeller sesame oil cake was found to contain 3.01 ppm thiamine, 3.87 ppm riboflavin, 13.44 ppm pyridoxine, 6.45 ppm pantothenic acid, 32.26 ppm niacin and 1651.6 ppm choline (N.R.C. 1994).

Table 2: Proximate composition, calcium and phosphorus content of sesame oil cake (% DM)

Nutrients	Ghani cake				Hydraulic or Expeller or Rotary pressed oil cake		Expeller cake			Solvent extracted cake	
					Grade High fat	Grade Low fat					
Dry matter	---	---	---	---	90.00	90.00	90.70	93.00	94.95	92.00	90.00
Crude protein	---	39.10	35.00	35.60	40.00	42.00	39.10	47.10	47.10	41.00	45.00
Crude fibre	---	4.20	2.40	2.50	7.00	7.00	4.70	7.53	9.97	7.00	7.20
Ether extract	---	9.20	5.10	5.40	8.00	5.00	9.30	6.99	9.25	---	3.00
Nitrogen free extract	---	---	34.30	34.30	---	---	34.30	---	---	---	---
Total ash	11.60	---	12.60	---	13.00	13.00	---	---	10.35	---	---
Calcium	2.07	2.40	2.00	2.00	---	---	2.46	2.14	2.35	---	2.20
Phosphorus	1.07	1.40	1.12	1.12	---	---	1.42	1.47	1.53	---	---
Available phosphorus	---	---	---	---	---	---	---	0.37	0.77	---	0.33
Acid insoluble ash	---	---	---	---	1.50	2.00	---	---	---	3.00	---
References	Pathak and Kamra (1989)	Chand *et al.* (1991)	Hasan and Khandaker (2000)	Aziz *et al.* (2001)	I.S.I. (1961)		I.S.I. (1980)	N.R.C. (1994)	Mamputu and Buhr (1995)	Mehta (2000)	Robert Swick (2001)

Table 3: Amino acid composition of sesame seed protein (g/16 g N)

S. No.	Amino acids	Whole seed	Dehulled seed
1.	Arginine	12.0 – 13.0	9.5
2.	Cystine	-------	2.0
3.	Histidine	2.4 – 2.8	2.1
4.	Isoleucine	3.3 – 3.6	4.9
5.	Leucine	6.5 – 7.0	8.9
6.	Lysine	2.5 – 3.0	3.2
7.	Methionine	2.5 – 4.0	3.3
8.	Methionine + Cystine	3.8 – 5.5	-------
9.	Phenylalanine	4.2 – 4.5	6.2
10.	Threonine	3.4 – 3.8	3.6
11.	Tryptophan	2.0 – 2.4	1.9
12.	Valine	4.2 – 4.4	4.5
	References	Evans & Bandemer (1967)	Mehta (2000)

Table 4: Amino acid composition of sesame oil cake (g/16 g N)

S.No.	Amino acids	Ghani cake	Expeller cake			Solvent extracted cake
1.	Alanine	---	---	---	2.29	---
2.	Arginine	12.80	4.21	8.25	3.73	5.34
3.	Aspartic acid	---	---	---	3.29	---
4.	Cystine	2.10	0.53	1.76	0.22	1.01
5.	Glutamic acid	---	---	---	8.25	---
6.	Glycine	---	3.69	3.62	2.33	---
7.	Histidine	---	0.97	1.76	1.03	---
8.	Hydroxylysine	---	---	---	0.02	---
9.	Hydroxyproline	---	---	---	0.11	---
10.	Isoleucine	---	1.84	3.66	1.76	---
11.	Lanthionine	---	---	---	0.04	---

12.	Leucine	---	9.98	6.55	3.14	---
13.	Lysine	2.90	1.14	2.20	0.56	1.10
14.	Methionine	3.10	1.23	3.00	1.41	1.27
15.	Ornithine	---	---	---	0.32	---
16.	Phenylalanine	4.30	1.93	4.70	2.09	---
17.	Proline	---	---	---	1.65	---
18.	Serine	---	---	3.06	0.84	---
19.	Taurine	---	---	---	0.03	---
20.	Threonine	---	1.40	3.40	1.17	1.53
21.	Tryptophan	---	0.69	1.50	0.59	0.61
22.	Tyrosine	3.90	1.76	3.60	1.60	---
23.	Valine	---	2.10	4.63	2.29	---
	References	Pathak and Kamra (1989)	I.S.I. (1980)	N.R.C. (1994)	Mamputu and Buhr (1995)	Robert Swick (2001)

1.1.6 Antinutritional Factors

1.1.6.1 Phytates

Toma *et al*. (1979) estimated the phytin content in whole, dehusked, roasted, dehusked and roasted sesame seeds and reported the phytic acid values to be 4.7, 5.2, 4.7 and 5.1% respectively and inferred a positive relationship between total phosphorus and phytic acid content. Decortication of seeds had little effect on the phytate levels (Reddy *et al*., 1982). The deleterious effect of phytates on the performance of chicken was evaluated by many authors. Georgievskii *et al.* (1982) revealed that the insoluble phytates present in sesame seed cakes forms complex with zinc, phosphorus and calcium, which is not absorbed. Sebastian *et al*. (1998) reported that the phytin reduces digestibility of protein through binding with carbohydrates and inhibiting alpha amylase activity in the digestive tract. Mamputu and Buhr (1995) observed that the phytate content of sesame meal may lower the feed intake in broilers.

1.1.6.2 Oxalates

Pirie (1975) reported that the sesame seed contained 1 to 2% oxalic acid in the thin hull and removal of the hull was found to reduce the bitter taste of the meal. Toma *et al*. (1979)

estimated the total oxalates in whole, dehusked, roasted, dehusked and roasted sesame seeds and reported a total oxalate level of 458.5, 278.7, 437.4 and 242.6 µg/g respectively. They also recorded a positive relationship between calcium and soluble oxalates in dehusked roasted seeds. Reddy *et al*. (1982) inferred that the decortication of seed was found to almost completely remove the oxalates. Aherne and Kennelly (1985) stated that the oxalates present in the sesame oil cake has been found to give a darker colour and bitter taste to the meal. Leeson and Summers (2001) inferred that oxalic acid salts of calcium and magnesium are insoluble crystals, which are not absorbed.

Table 5: Fatty acid composition of sesame oil (%)

S.No.	Fatty acids		1	2
1.		C < 14	-----	< 0.1
2.	Myristic	C 14 : 0	0.1 – 0.2	< 0.5
3.	Palmitic	C 16 : 0	7.8 – 9.1	7.0 – 12.0
4.	Palmitoleic	C 16 : 1	-----	< 0.5
5.	Stearic	C 18 : 0	3.6 – 4.7	3.5 – 6.0
6.	Oleic	C 18 : 1	45.3 – 49.4	35.0 – 50.0
7.	Linoleic	C 18 : 2	37.7 – 41.2	35.0 – 50.0
8.	Linolenic	C 18 : 3	-----	< 0.1
9.	Arachidic	C 20 : 0	0.4 – 1.1	< 1.0
10.	Gadoleic	C 20 : 1	-----	< 0.5
11.	Behenic	C 22 : 0	-----	< 0.5
	References		Ravindran (1990)	Mehta (2000)

1.1.7 Mycotoxins

The literature on the incidence of aflatoxin in sesame oil cake is scanty. Mirocha *et al*. (1976) reported the presence of *Fusarium* toxins in sesame seeds. While Laxma Reddy and Reddy (1994) observed the incidence of trichothecene producing fungi was low as compared with that of *Aspergillus* and *Penicillium* species in sesame oil cake.

1.1.8 Keeping Quality of Sesame Oil Cake

In general the keeping quality of sesame oil cake is better than other vegetable oil cakes. This is attributed to the presence of tocopherols, antioxidants like sesamol, sesaminol glucoside (12.4 mg/100 g) and antioxidant precursor like sesamin and sesamolin in the sesame seeds (Ranken *et al*., 1997).

Based on the review on chemical composition of sesame oil cake it can be used in livestock and poultry ration.

REFERENCES

[1] Aherne, F.X. and J.J. Kennelly, 1985. Oilseed meals for livestock feeding. In: Recent Developments in Pig Nutrition (Ed) D.J.A. Cole, and W. Haresign. pp. 278-315. Butterworths, London.

[2] Aziz, M.A., Z.H. Khandaker, and M.M. Islam, 2001. Effect of replacing protein from fish meal with soyabean on the performance of broiler chicken. Poultry fortune, 3: 28 – 30.

[3] Chand, S., S.V.S. Verma, and H.P. Shrivastava, 1991. Vegetable-protein feedstuffs in poultry rations. Poultry Guide, 28 (9): 35 – 40.

[4] Evans, R.J. and S.L. Bandemer, 1967. Nutritive value of some oilseed proteins. Cereal Chemistry, 44: 417.

[5] Georgievskii, V.I., B.N. Annenkov, V.T. Samokhin, 1982. Mineral Nutrition of Animals. Butterworths, London. 49 p.

[6] Hasan, M. and Z.H. Khandaker, 2000. Comparative study of fish meal and other protein concentrates on the performance of broiler. Indian J. Anim. Nutr., 17: 95 – 98.

[7] I.S.I. 1961. Specification for sesamum (*Til*) oil cake as livestock feed IS: 1934-1961, Indian Standards Institution, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi.

[8] I.S.I. 1980. Nutrient requirements for poultry IS: 9863 – 1980, Indian Standards Institution, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi.

[9] Johri, T.S., Rashmi Agrawal and V.R. Sadagopan, 1988. Available lysine and methionine contents of some proteinous feedstuffs. Indian J. Anim. Nutr., 5: 228-229.

[10] Laxma Reddy, G. and S.M. Reddy, 1994. Incidence of trichothecene mycotoxin producing fungi in oil seed cakes. Indian J. Anim. Nutr., 11: 101-106.

[11] Leeson, S. and J.D. Summers, 2001. Nutrition of the chicken. 4th Ed., University Books, Canada. pp. 558-559.

[12] Mamputu, M. and R.J. Buhr, 1995. Effect of substituting sesame meal for soybean meal on layer and broiler performance. Poult. Sci., 74: 672 – 684.

[13] Mehta, B.V. 2000. Sea Millennium Handbook 2000. 7th Ed., The Solvent Extractors Association of India, Mumbai.

[14] Mirocha, C.J., S.V. Pathre, B. Schauerhamer, and C.M. Christensen, 1976. Applied and Environmental Biology, 32 : 4. Quoted by R. Gordon Hemingway, J. Scott Inglis, Andrew Waterston, 1997. The Proceedings of the Nutrition Society, 56 : 306 A (Abstract).

[15] N.R.C. 1994. Nutrient Requirements of poultry. 9th revised Ed., National Academy Press, Washington, D.C.

[16] Pathak, N.K. and D.N. Kamra, 1989. A text book of livestock feeding in tropics. A Falcon Book From Cosmo Publications, New Delhi. pp. 246 – 257.

[17] Pirie, N.W. 1975. Food protein sources. Cambridge University Press, Cambridge, London. pp. 93-96.

[18] Ranken, M.D., R.C. Kill, and C.G.J. Baker, 1997. Food Industries Manual. 24th Ed., Blackie Academic and Professional, London. pp. 280-281.

[19] Ravindran, V. 1990. Sesame meal. In: Nontraditional feed sources for use in swine production (Ed) P.A. Thacker, and R.N. Kirkwood. pp. 419-427. Butterworth Publishers, Boston.

[20] Reddy, N.R., S.K. Sathe, and D.K. Salunkhe, 1982. Phytates in legumes and cereals. Adv. Food Res., 28: 1 – 92.

[21] Robert Swick, 2001. Considerations in using protein meals for poultry. Poultry Fortune, 2(10): 30 – 38.

[22] Sebastian, S., S.P. Touchburn, and E.R. Chavez, 1998. Implications of phytic acid and supplemental microbial phytase in poultry nutrition: a review. World's Poultry Science Journal, 54: 27-47.

[23] Toma, R.B., M.M. Tabekhia, and J.D. Williams, 1979. Phytate and oxalate contents in sesame seed (*Sesamum indicum L.).* Nutr. Rep. Int., 20: 25 – 31.