PRINT: ISSN 0970-9274 ONLINE: ISSN 2456-6608
J Hum Ecol, 48(2): 341-346 (2014)
DOI: 10.31901/24566608.2014/48.02.15

Incorporation of Groundnut Meal in Selected Products after Removal of Aflatoxin

Shashi Jain, Dashrath Bhati* and Neha Saxena

Department of Foods and Nutrition , College of Home Science, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India
**E-mail: bhati.dashrath1@gmail.com*

KEYWORDS Aflatoxin. Groundnut Meal. Malnutrition. Novel Protein Source. Value Addition

ABSTRACT Groundnut meal is the high protein by-product remaining after commercial extraction of peanut oil. Groundnut meal applications are limited because of typical high concentrations of aflatoxin. In the present study technology was developed to prepare protein rich powder from an oil extracted groundnut. To make the meal free from aflatoxin four treatments were employed viz. ether treatment, heat treatment, acid-alkali treatment and homestead acid-alkali treatment. After each treatment, the powder was subjected to analysis of protein and aflatoxin and acceptability for sensory characteristics. A reduction ranged from 17.86 to 100 percent of aflatoxin and 29.17 to 70.47 percent of protein. A comparative evaluation of four powders indicated that homestead acid alkali treatment is free from aflatoxin and containing 10.09gm of protein. This powder was incorporated in three products, that is, *batti*, *besan laddu*, and sweet biscuits at 35 and 50 percent level. Acceptability was assessed on 9 point hedonic rating scale. The mean overall acceptability of reference, 35 percent and 50 percent incorporated *batti* were 8.1, 7.2 and 6.3, *besan laddu* 8.0, 7.3 and 6.8 sweet biscuits 7.6, 7.4 and 6.5 respectively, revealing that the developed powder is acceptable at moderate level in various products. No significant difference ($P>0.05$) was found between reference and 35 percent incorporated product and between 35 and 50 percent incorporated products. However, the 50 percent incorporated product scored significantly lower than the reference, specifically for colour and appearance. The study concluded that aflatoxin can be removed from groundnut meal and further, can be used in different recipes as protein source.

INTRODUCTION

Food industry by product utilization is both, a necessity and a challenge. In the food industry, the recovery and modification of by product wastes is becoming increasingly important. Roughly one-third of the edible parts of food produced for human consumption gets lost or wasted globally, which is about 1.3 billion ton per year (Gustavsson et al. 2011). The management of these by product wastes is becoming extremely difficult due to legislative restrictions on landfill. On the other hand, the population is increasing every day. The world's population passed 7 billion people in 2011 and by 2050 is expected to exceed 9 billion people. This growth puts intense pressure on the food supply that is intricately linked to global political stability and ecological sustainability (Aiking 2011). These food wastes account as a source of valuable nutrients which acts as nutraceuticals (Schieber et al. 2001; Sonja et al. 2009) and deal with the prospects of feeding fast growing population in 21st century (Parfitt et al. 2010). Processing of such food industrial waste may an immense source of priceless and valuable nutrients to meet the nutritional requirement of the population and to reduce wastes. In addition, the need to develop sustainable reuse technologies and processes, to restrain the loss of added-value compounds attached to these by product wastes.

Groundnut meal is the primary by-product of commercial oil crushing operations, is an excellent source of protein although aflatoxin contamination often limits applications for this material. Groundnut meal has been reported to contain about 30 to 40 percent of protein content but at the same time aflatoxin growth in this meal make it un-utilizable for human being. Aflatoxin is an unavoidable contaminant in groundnut meal. The groundnut meal if made free from aflatoxin can serve as good source of protein within the reach of economically backward population. Thus, there is a strong need to develop technology involving simple processing form locally available foods to improve the protein energy content of daily diet and may be helpful in preventing and overcoming malnutrition within the economic reach of poor families. Hence, in the present study an attempt was made to make the groundnut meal powder free from aflatoxin and its incorporation in recipes.

MATERIAL AND METHODS

Groundnut meal was procured from a reputed oil extracting industry. The procured sample was cleaned to remove dirt, waste material, hulls, etc. The cleaned groundnut meal sample was ground by using electric grinder and passed through 2mm mesh size sieve to obtained smooth fine powder. The raw groundnut meal was analyzed for its proximate composition that is moisture, total ash, fat, protein, fibre and carbohydrate using standard method (NIN 2003).

The groundnut meal was subjected to processing viz. solvent extraction, heat treatment, acid-alkali treatment and home stead acid alkali treatment to make it free from aflatoxin (Basappa and Shantha 1996).The detailed method of all the processing is shown in in Figure 1.

Each treated sample was analysed for protein and aflatoxin content to know the effect of processing on removal of aflatoxin and retention of protein content in meal. Aflatoxin was estimated in lab using competitive ELISA test. Sensory evaluation of the treated powder were also done for their appearance, colour, flavour, texture, taste and over all acceptability on nine point hedonic rating scale (Swaminathan 1987). For sensory evaluation 10 members were selected by threshold method. On the basis of protein retention, aflatoxin removal and organoleptic qualities one powder was selected for the product development. The selected [illegible] were *batti*, *besan laddu* and sweet biscuits. The powder was incorporated at 0 (reference) 35 and 50 percent by replacing flour of basic recipe. Each product was evaluated for their sensory characteristics by the panel member on nine point hedonic rating scale.

RESULT AND DISCUSSION

Proximate Composition of Raw Groundnut Meal

The proximate composition of the procured groundnut meal was estimated and the values are presented in the Figure 2. The moisture and protein content estimated were 8.88 and 34.17 percent respectively in raw meal. The ash, fibre, fat and carbohydrate content were found to be 7.5, 9.99 and 35.01per cent respectively. Energy content was estimated to be 340 kcal in the groundnut meal. Whereas the aflatoxin content of meal was 527 ppm.

Table 1 shows the estimated values of protein and aflatoxin in the groundnut meal after treatment. Protein content was observed maximum in solvent extracted powder (25.2 g/100g) followed by heat treatments (22.87 g/100g), acid-alkali treatment (11.6 g/100g) and home stead acid alkali treatment (10.0 g/100g). The results of treatment in the present study also indicate that the possible affinity of aflatoxin to protein (Basappa and Shantha 1996). The processing methods reduced aflatoxin content to a variable extent. There was 17.86 percent to 100 removal of aflatoxin content in solvent extracted and home stead acid alkali treatment respectively. Results of present study are in agreement with the report of Basappa (1983) indicated that the toxin is sparingly soluble in fat solvents. Aflatoxin contamination in coffee beans is reduced during the traditional roasting process which subjects beans to 180 ^{o}C for 18 min (Soliman 2002). Overall, any change in physical, chemical or biological means would reduce the toxicity (Samarajeewa et al. 1990). In acid and alkali treatment alteration in pH brought structural degradation and inactivation was found to be the possible reason of reduction of aflatoxin in groundnut meal. Similar observation was also noted by (Oakes et al. 2013; Basappa and Shantha 1996). Treatments with acid and alkali showed a reduction of 99 to 100 percent aflatoxin. Homestead acid alkali treatment is better than acid alkali treat- hemicals are already in use for various food preparations and are less prone to consumer resistance.

Organoleptic Evaluation of Powder: Average values for organoleptic evaluation of the treated powder are presented in Table 2. Overall acceptability ranged between 5.3 and 6.9 on nine point hedonic rating scale for acid-alkali treatment and solvent extraction treatment respectively. All the treated groundnut meal powder was found to be acceptable for appearance, colour, flavour, texture and taste. Acceptability of any product mainly depends on its taste and appearance. Among all the four treatments, solvent extracted and heat treated powder was found to be superior then acid alkali and home stead acid alkali treatment but both were containing aflatoxin content. Homestead acid-alkali treated powder was very light brown in colour, very fine in texture. Hence home stead acid alkali treated powder was selected for incorporation in recipe to enhance protein content.

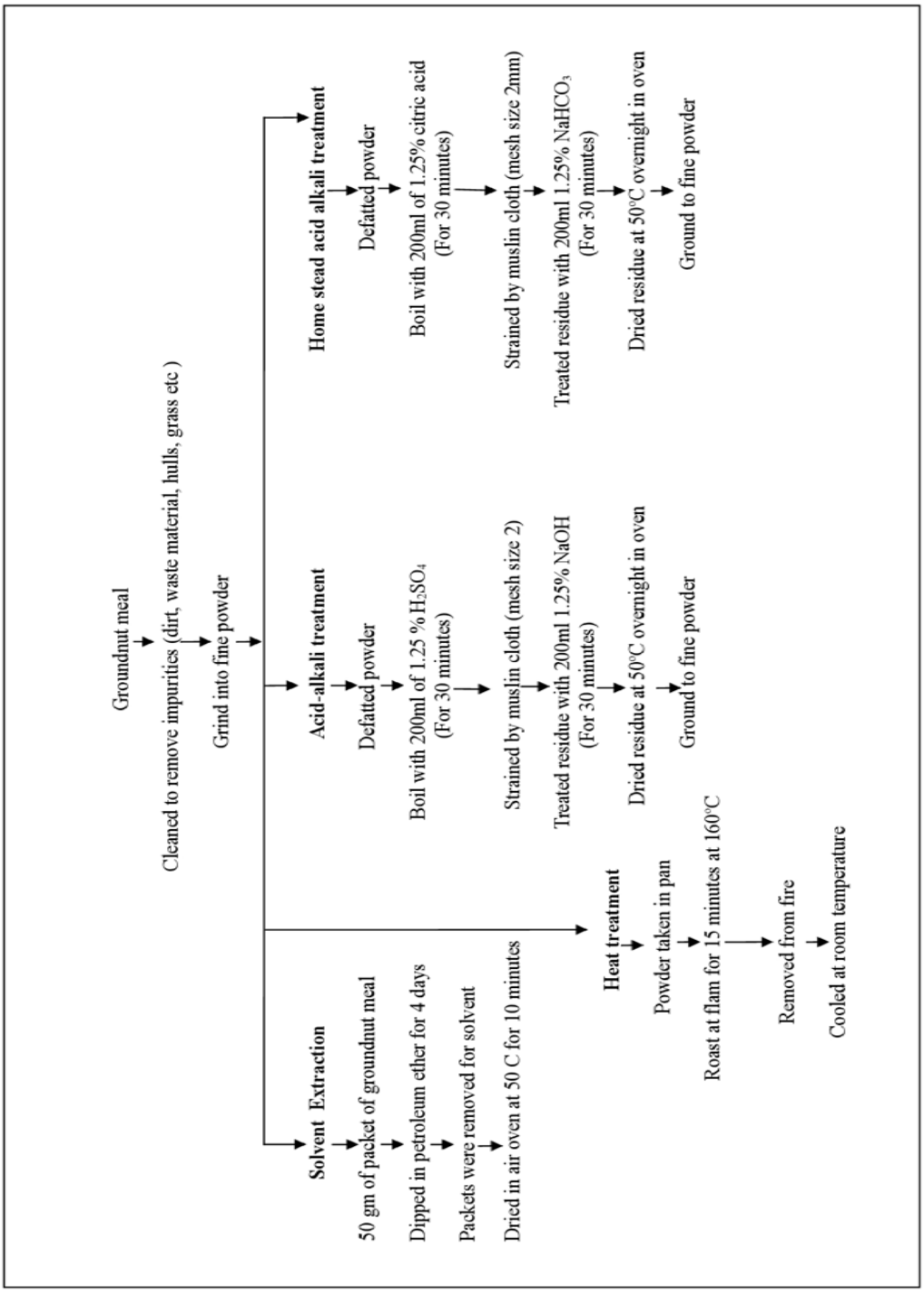

Fig. 1. Flow chart for processing of groundnut meal

Table 1: Protein and aflatoxin content of various treated powder

S. No.	*Name of treatment*	*Protein content (g/100g)*	*Aflatoxin content (ppm)*	*Percent reduction of Protein*	*Percent reduction of Aflatoxin*
1	Raw groundnut meal	34.17	527	-	-
2	Solvent extraction	25.2g	43	29.17	17.86
3	Heat treatment	22.87g	13	33.06	75.89
4	Acid alkali treatment	11.6g	0.02	66.05	99.62
5	Home stead acid-alkali treatment	10.0g	0.00	70.47	100.0

Sensory Evaluation of Products

Batti: Mean scores sensory scores are presented in Table 3 and it shows that 35 percent incorporated *batti* obtained good acceptability for all the organoleptic parameters with average acceptability score of 7.2. Further mean score reveals that 50 percent incorporated products had obtained a mean score of 6.3 in overall acceptability means that the product was liked slightly by the panel member. Overall mean scores indicates that 50 percent incorporated groundnut meal powder was liked least. There was no significant difference noted between reference and 35 percent incorporated *batti* preparation. The significant variation was noted for all the sensory attributes between 50 percent incorporation and reference *batti*.

Besan Laddu: The 35 percent incorporated *besan laddu* was moderately liked by the panel members. Mean score of 50 percent incorporated *besan laddu* ranged between 6.3 to 6.8 indicates that the product was liked slightly by the panel members (Table 3). Among all the variation of *besan laddu* 35 percent incorporation was found at par with reference *besan laddu*. Significant variation was observed in 50 percent incorporated *besan laddu* and reference product. No significant difference was recorded for 35 percent and 50 percent incorporated groundnut meal *besan laddu.*

Sweet Biscuit: The sweet biscuit prepared with 35 percent incorporated groundnut meal was moderately accepted by the panel members. However, the mean score obtained for appearance, flavour and taste was 6.9, 7.5 and 7.6 respectively (Table 3). Whereas 50 percent incorporated groundnut meal obtained least mean overall acceptability score. There was no significant variation noted between 35 percent incorporated and reference sweet biscuit. In comparison to reference and 50 percent incorporated sweet biscuit, significant difference was observed for appearance, colour and overall acceptability.

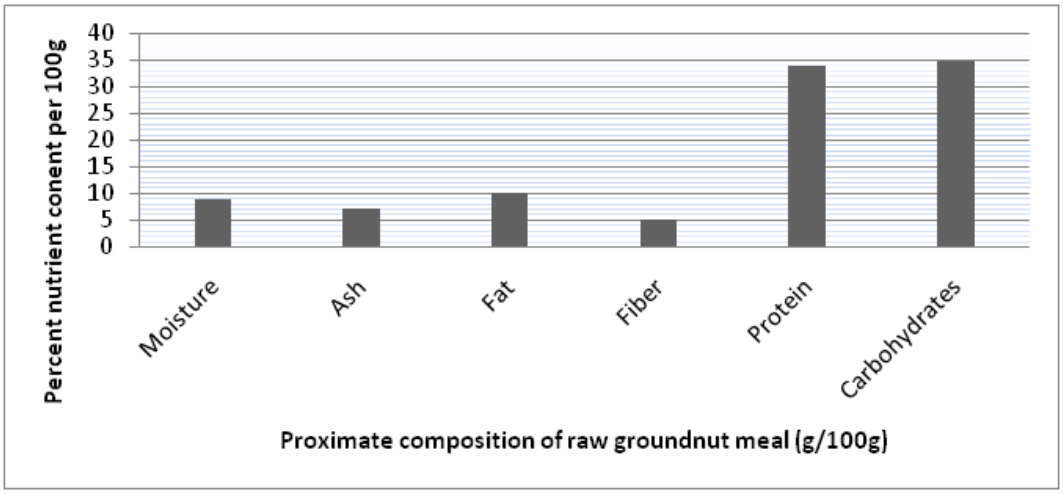

Fig. 2. Proximate composition (g/100g) of groundnut meal

Table 2: Mean ± SD score of organoleptic characteristic of treated powder

Treatment Parameters	*Raw groundnut meal*	*Solvent extraction*	*Heat treatment*	*Acid-alkali treatment*	*Homestead acid-alkali treatment*
Colour	6.3 ± 1.3 (0.29)	6.8 ± 1.8 (0.40)	6.2 ± 2.3 (0.51)	4.9 ± 1.9 (0.42)	5.7 ± 1.5 (0.33)
Texture	5.7 ± 1.4 0.31)	7.2 ± 1.7 (0.38)	5.75 ± 1.6 (0.35)	5.2 ± 2.3 (0.51)	5.95 ± 1.8 (0.40)
Flavour	5.2 ± 1.3 (0.29)	6.8 ± 1.9 (0.42)	5.4 ± 2.6 (0.58)	5.75 ± 1.8 (0.40)	6.1 ± 1.7 (0.38)
Appearance	6.6 ± 1.3 (0.28)	7 ± 1.5 (0.35)	6.55 ± 1.9 (0.42)	5.35 ± 1.5 (0.33)	5.95 ± 1.5 (0.33)
Taste	5.9 ± 1.54 (0.34)	6.75 ± 2.05 (0.45)	4.9 ± 2.5 (0.55)	5.4 ± 2.2 (0.49)	5.4 ± 1.9 (0.42)
Overall acceptability	6.3 ± 1.6 (0.35)	6.9 ± 1.7 (0.38)	5.55 ± 2.2) (0.49)	5.3 ± 1.7 (0.38)	5.85 ± 1.8 (0.40)

Table 3: Mean ± SD scores of organoleptic evaluation of standard, 35 percent incorporated and 50 percent incorporated *batti, besan laddu* and sweet biscuit

Batti Parameters Per cent incorporation	*Appearance*	*Colour*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Reference	8.1±0.7 (0.22)	7.8±0.6 (0.19)	7.8±0.6 (0.19)	7.5±0.8 (0.26)	8.1±0.7 (0.22)	8.1±0.5 (0.17)
35 percent incorporation	7.6±0.8 (0.25)	7.3±0.9 (0.28)	7.2±0.9 (0.31)	6.9±0.7 (0.22)	7.3±1.1) (0.35)	7.2±1.1 (0.35)
50 percent incorporation	6.1±1.1 (0.36)	6.2±0.9 (0.31)	6.3±0.9 (0.28)	6.7±0.9 (0.28)	7.0±1.2 (0.38)	6.3±0.8 (0.25)
Besan Laddu Parameters Per cent incorporation	*Appearance*	*Colour*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Reference	8.4±0.7 (0.21)	8.0±0.7 (0.20)	7.3±0.7 (0.20)	7.9±0.35 (0.17)	7.5±0.8 (0.26)	8.0±0.45 (0.14)
35 percent incorporation	7.3±0.6 (0.20)	6.9±0.7 (0.22)	6.7±1.7 (0.54)	7.0±1.2 (0.40)	7.4±1.5 (0.49)	7.3±1.4 (0.44)
50 percent incorporation	6.8±1.3 (0.42)	6.3±1.6 (0.53)	6.5±1.0 (0.32)	6.5±1.3 (0.32)	6.6±1.3 (0.40)	6.8±1.2 (0.39)
Sweet Biscuit Parameters Per cent incorporation	*Appearance*	*Colour*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Reference	7.7± 1.12 (0.38)	7.4±1.2 (0.37)	7.4±1.3 (0.41)	7.3±1.00 (0.35)	7.7 ±1.1 (0.35)	7.6 ± 1.09 (0.35)
35 percent incorporation	6.9 ± 0.8 (0.26)	6.6 ±0.5 (0.16)	7.5 ±0.7 (0.21)	7.1±1.00 (0.32)	7.6 ±0.8 (0.25)	7.4 ± 1.01 (0.32)
50 Percent incorporation	6.2 ± 1.07 (0.34)	6.0 ±1.3 (0.40)	(0.38) (0.38)	(0.42) (0.42)	(0.51) (0.51)	(0.43) (0.43)

CONCLUSION

Today, food wastes are being considered as a cheap source of valuable components. Since the existing technologies allow the recovery of target compounds and their recycling inside food chain as functional additives in different products. The groundnut meal could be made

free from aflatoxin content using acid and alkali treatment at household level. This protein rich powder could be incorporated in recipes up to 35 percent level without affecting the acceptability of product.

REFERENCES

Aiking H 2011. Future protein supply. *Trends in Food Science and Technology*, 22: 112–120

Basappa SC, Shantha T 1996. Methods for detoxification of aflatoxin in foods and feeds- Acritical appraisal. Review Paper. *Journal of Food Science and Technology*, 33(2): 95-107.

Basappa SC 1983. Physical methods of detoxification of aflatoxin contaminated materials. In: KS Bilgrami, T Prasad, KK Sinha (Eds.): *Mycotoxins in Food and Feed*. Bhagalpur: The Allied Press, pp. 251-273.

Gustavsson J, Cederberg C, Sonesson U, Van Otterdijk R, Meybeck A 2011. Global Food Losses and Food Waste - Extent, Causes and Prevention, International Congress Save Food! From <http://www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf.> (Retrieved on 8 September 2013).

NIN 2003. *A Manual of Laboratory Techniques*. International Institute of Nutrition. Hyderabad, India: Indian Council of Medical Research.

Oakes AJ, White BL, Lamb M, Sobolev V, Sanders TH, Davis JP 2013. Process development for spray drying a value-added extract from aflatoxin-contaminated peanut meal. *International Journal of Food Science and Technology*, 48: 58–66. doi: 10.1111/j.1365-2621.2012.03158.

Parfitt J, Barthel M, Macnaughton S 2010. Food waste within food supply chains: Quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B*, 465: 3065–3081.

Samarajeewa U, Sen AC, Cohen MD, Wei CI 1990. Detoxification of aflatoxin in food and feed. *Journal of Food Prot*, 53: 489-501.

Schieber A, Stintzing FC, Carle R 2001. By-products of plant food processing as a -source of functional compounds- recent developments. *Trends in Food Science and Technology*, 12: 401–413.

Soliman KM 2002. Incidence, level, and behavior of aflatoxins during coffee bean roasting and decaffeination. *Journal of Agricultural and Food Chemistry*, 50(25): 7477– 7481.

Sonja D, Canadanovic-Brunet J, Cetkovic G 2010. By-products of fruits processing as a source of phytochemicals. *Chemical Industry and Chemical Engineering*, 15: 191–202.

Swaminathan M 1987. *Sensory Method of Analysis of Foods: Food Science and Experimental Foods*. Bangalore: The Bangalore Printing and Publication Co. Ltd.