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Nutritional Composition and Sensory Evaluation of Wheat and Millet Flour Pasta Noodles

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Abstract: *The objective of the study was to produce a fortified pasta noodles from strong wheat and millet flour blends in a ratio: 100:0, 50:50 and 70:30. Proximate composition results of the noodle produced indicated an increasing level of moisture, 9.02-10.56%, ash, 1.46-1.55%, fat, 34.96-37.40%, protein, 13.80-14.64% and carbohydrate, 36.55-39.96%. The sensory properties of the noodles showed a significant ($p<0.05$) difference between all fortified samples and the control. Sample C (70% wheat flour and 30% millet flour) had the highest mean score of (4.80%) followed by sample A (100% wheat flour) with 4.50%. Sample C was the most accepted followed by samples A.*

Keywords: wheat, millet, composite flour, pasta, noodles, proximate composition, sensory evaluation.

1. INTRODUCTION

Wheat (*Triticum aestivum L.)* flour is the significant raw material used in many bakery industries in Ghana and Africa [1]. The use of wheat in the preparation of numerous confectionaries has become well-known due to the inherent viscoelastic properties of the wheat protein [2]. It contains 78.10% sugars, 14.7% protein, 2.10%, fat, 2.10% minerals and critical measures of nutrients, for example, thiamine and vitamin B [1]. As per [3], the importation of wheat in West Africa has become a critical issue since an amount of 635 billion Ghana cedis is spent on importation of wheat into the country every year. According to [4] wheat has been accounted for to be low in fundamental supplement, for example, lysine and has additionally been embroiled for the occurrence of celiac disease: a foundational immune mediated disease caused by the ingestion of gluten found wheat grains [5]. Because of these, few attempts are made to eradicate the issues related with wheat utilization using locally accessible raw materials [6], [7]; [8]; [9]; [10]; [11].

Millet is a gluten free but low cost cereal with nearly 40% lower than the cost of corn, which is resistant to dry season and supplement infertile soil [12]. In 2011, the worldwide millet production was about 27.5 million tones (Food and Farming Association, 2015). Nations in Africa and Asia delivered 56% and 41% of the all-out world production separately [13]. Millet is a better cereal crop with respect to the wholesome quality and presents a few medical advantages [14]. It is rich in dietary fiber, calcium, oleic corrosive (25%) and linoleic corrosive (46%) [13]. Additionally, millet is an intense source of cancer prevention agents, due of its phenolic content [15]; [13] and is a staple food substitute for celiac patients who require gluten free cereal products [13]. Because of its nourishing qualities and minimal effort, there is an expanded interest in millet due to its medical advantages, hypoglycemic attributes [16] and because of the antimicrobial and cell reinforcement exercises of its polyphenols [17]. Also, as millet does not contain gluten and is known for its low starch focus and low glycemic record [18] ; [19], a few writers has envisaged its practicality in pastry making, for example, breads, rolls and pasta [20]; [21]; [22]. The adequacy of the pastry products prepared with millet flour is accounted for to be generally excellent [21]; [22].

Pasta is a type of food produced using durum wheat flour and molded into structures, for example, macaroni, noodles, ravioli and spaghetti [23]. It is perhaps the most common source of carbohydrate in the diet of mankind. Production and utilization of pasta items differ depending upon the area of the world and culinary customs [24]. Spaghetti utilization has expanded ceaselessly in many non-industrial nations and this has changed dietary patterns of entire populace and in light of the fact that a huge extent of the incomes of the consumers determines the sort of pastry item to purchase [25]. Notwithstanding, the wheat flour required for making spaghetti is imported, the climatic conditions and soil does not allow wheat to be grown locally [25].

Accordingly, research interest in composite flours has been on the rise in the past years, driven by the longing to discover non-wheat spaghetti making thereby diminishing non-wheat delivering nations' reliance on imported wheat [26]. Much exertion has been made to advance the utilization of composite flours, in which a bit of wheat flour is supplanted by privately developed yields, in bread, subsequently diminishing the expense related with imported wheat [1] which is turn diminishes the interest for imported wheat while grains have additionally been utilized to get ready gluten free Spaghetti [27], [28]. The main aim of the study was to produce and undertake a proximate composition of pasta noodles using wheat and millet flour blends.

2. MATERIALS AND METHODS

2.1 Source of Raw Material

The millet, wheat flour, eggs, salt and flavour were obtained from the Bolgatanga Market in the Upper East Region, Ghana.

2.2 Millet flour

Millet grains were sorted, washed and dried in a Nasco gas oven at 60^{o}C for 12 hours. The dried millet was ground with a Philip blender and sieved with a 3-mm particle size under continuous suction. The millet flour was stored at (–22 °C) until further analysis.

2.3 Preparation of blends of wheat and millet flour

Three different samples were formulated and were coded as sample A, B and C. Wheat and millet flour were blended at ratios 100:0, 50:50, and 30:70, with 100% wheat flour serving as the control sample. The samples were mixed with the help of a benatone Mixer to obtain consistent samples.

Table 1: Formulation of Composite Flour and other Ingredients for biscuit Production

INGREDIENTS	A	B	C
Strong wheat flour (g)	200	100	70
Millet flour (g)	0	100	30
Cooking oil (ml)	125	125	125
Whole Egg	1	1	1
Salt (g)	1	1	1

Sample A (100% wheat flour), sample B (50% millet flour and 50% wheat flour) sample C (30% millet flour 70% wheat flour)

2.4 Method of preparation

Pasta was prepared using the method adopted by [29] with minor modifications. Flour was sifted together with salt and formed a well. Egg and oil were beating and combined with flour to form smooth and developed dough. The dough was covered with a clean damped cloth and rested in a cool place for 30 minutes. The dough was rolled into 36 cm (inches) wide thin sheet, and was dusted with strong flour. Each sheet was rolled into a cylindrical shape and was cut immediately into 3 mm (1/8 in) widths. Strips were unrolled and allowed to dry in an oven at 65^{o}C for 5 h and packaged inside high density polyethylene bag.

2.5 Proximate composition of noodles

Moisture content and total solids: Oven Drying Method

Five grams (5g) of the sample was transferred to the previously dried and weighed dish. The Dish was placed in an oven and thermostatically controlled at 105 degrees for 5 hours. Dish was removed and placed in a desiccator to cool to room temperature and weighed. It was then dried again for 30 minutes, cooled down again and weighed. Drying, cooling and weighing were repeated until a constant weight was reached. (Alternatively, sample could be dried in a thermostatically controlled oven for at least 8 hours where a constant weight would be achieved). The determinations were duplicated and the average found [30].

Calculations

$$\%\text{ Moisture (wt/wt)} = \frac{\text{wt } H_2O \text{ in sample}}{\text{Wt of wet sample}} \times 100$$

$$\%\text{ Moisture (wt/wt)} = \frac{\text{wt of wet sample-wtof dry sample}}{\text{Wt of wet sample}} \times 100$$

$$\%\text{ Total solids (wt/wt)} = \frac{\text{wt of dried sample}}{\text{Wt of wet sample}} \times 100$$

Where wt= Weight of sample/spread

Ash content

5g sample was weighed into a tarred crucible and was pre-dried. Crucibles were placed in cool muffle furnace using tongs, gloves and protective eyewear. The crucibles Ignited for 2 hours at about 600 degrees Celsius. Muffle furnace was turned off and opened when temperature dropped to at least 250 degrees preferably lower. The door was carefully opened to avoid losing ash that may be fluffy. Safety tongs was used to transfer crucibles to a desiccator with a porcelain plate and desiccant. Desiccator was closed and allowed crucibles to cool prior to weighing.

Calculations

$$\%\text{Ash} = \frac{\text{wt of ash}}{\text{Wt of sample}} \times 100$$

$$\%\text{Ash} = \frac{(\text{wt of crucible+ ash}) - \text{wt of empty crucible}}{(\text{wt of crucible+ sample}) - \text{wt of empty crucible}} \times 100$$

Where wt= Weight of sample/spread

Fat content: soxhlet extraction

Previously dried (air oven at 100°C) 250 ml round bottom flask was weighed accurately. 5.0g of dried sample to 22 ×80mm paper thimble or a folded filter paper was weighed. A small of cotton or glass wool was placed into the thimble to prevent loss of the sample. 150ml of petroleum spirit B.P 40-60°C was added to the round bottom flask and assembled the apparatus. A condenser was connected to the soxhlet extractor and reflux for 4 - 6 hours on the heating mantle. After extraction, thimble was removed and recovered solvent by distillation. The flask and fat/oil was heated in an oven at about 103°C to evaporate the solvent. The flask and contents were cooled to room temperature in a desiccator. The flask was weighed to determine weight of fat/oil collected.

$$\% \text{ Fat (dry basis)} = \frac{\text{fat/oil collected} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Fat (dry basis)} = \frac{(\text{wt of flask + oil}) - \text{wt. of flask} \times 100}{\text{Weight of sample}}$$

Crude fibre determination

Two grams (2g) of the sample from crude fat determination was weighed into a 750ml Erlenmeyer flask. Two hundred milliliters (200ml) of 1.25% H_2SO_4 was added and immediately flask was set on hot plate and connected to the condenser. The contents were boiled within 1 minute of contact with solution. At the end of 30 minutes, flask was removed and immediately filtered through linen cloth in funnel and washed with a large volume of water. Filtrate (containing sample from acid hydrolysis) was washed and returned into the flask with 200ml 1.25% NaOH solutions. Flask was connected to the condenser and was boiled for exactly 30 minutes. It was then filtered through Fischer's crucible and washed thoroughly with water and added 15ml 96% alcohol. Crucible and contents was dried for 2 hour at 105 °C and cooled in desiccator and it was weighed. Crucible was ignited in a furnace for 30 minutes and after that it was cooled and reweighed.

$$\% \text{ Crude fibre} = \frac{\text{weight of crude fibre} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Crude fibre} = \frac{\text{wt of crucible + sample (before – after) ashing} \times 100}{\text{Weight of sample}}$$

Where wt= Weight of sample/spread

Protein Determination

Digestion Method

Two grams (2g) of sample and a half of selenium –based catalyst tablets and a few anti -bumping agents were added to the digestion flask. Twenty five milliliters (25ml) of concentrated H_2SO_4 was added and the flask was shaken for the entire sample to become thoroughly wet. Flask was placed on digestion burner and heated slowly until boiling ceased and the resulting solution was clear. The sample was then cooled to room temperature and digested sample solution was transferred into a 100ml volumetric flask and made up to the mark.

Distillation Method

To flush out the apparatus before use, distilled water was boiled in a steam generator of the distillation apparatus with the connections arranged to circulate through the condenser, for at least 10 minutes. The receiving flask was lowered and continued to heat for 30 seconds in order to carry over all liquid in the condenser. 25 ml of 2% boric acid was pipetted into 250ml conical flask and 2 drops of mixed indicator added. The conical flask and its contents were placed under the condenser in such a position that the tip of the condenser is completely immersed in solution. 10ml of the digested sample solution was measured into the decomposition flask of the Kejdahl unit, fixed it and add excess of 40% NaOH (about 15-20ml) to it. The ammonia produced was distilled into the collection flask with the condenser tip immersed in the receiving flask till a volume of about 150ml– 200ml is collected. Before distilling another sample and on completion of all distillations, the apparatus was flushed as in step 1 above. Steam was allowed to pass only until 5ml of the distillate is obtained.

Titration Method

The Distillate with 0.1N HCL solution was titrated. The acid was added until the solution became colourless. Any additional acid added made the two solutions become pink. The nitrogen content was determined in duplicate, and a blank determination was run using the same amount of all reagents as used for the sample. The blank was meant to correct for traces of nitrogen in the reagents and included digestion as well as distillation methods.

Calculation:

$$\% \text{ Total nitrogen} = \frac{100 \times (Va-Vb) \times NA \times 0.01401 \times 100}{W \times 10}$$

Where:

Va- volume in ml of standard acid used in titration
Vb- volume in ml of standard acid used in blank
NA- normality of acid
W- Weight of sample taken

Carbohydrate content

The calculation of available carbohydrate (nitrogen-free extract-NFE) was made after completing the analysis for ash, crude fibre, ether extract and crude protein. The calculation was made by adding the percentage values on dry matter basis of these analysed contents and subtracting them from 100%.

Calculation:

Carbohydrate (%) = % crude fibre + % NFE
OR
Carbohydrate (%) =100 - (% moisture +% fat +% protein +% ash)

x. Calculation for dry basis = $\frac{(100-\% \text{ moisture}) \times \text{wet basis}}{100}$

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2.6 Sensory evaluation

Sensory evaluation was carried out by a panel of 50 judges made up of staff and students of the Department of Catering and Hospitality Management, Bolgatanga Technical University, Ghana using 9-point Hedonic scale. The characteristics evaluated included appearance, texture, taste, flavour and overall acceptability.

2.7 Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) and separation of the mean values was carried out using Duncan multiple range tests and significant difference between any two means was accepted at $p < 0.05$.

3. RESULTS AND DISCUSSION

Table 2: Sensory Evaluation of Noodles produced

Samples	Colour	Texture	Aroma	Taste	Level of acceptability
A	4.80±0.7	4.10±0.80	4.3±0.80	4.50±0.80	4.50±0.70
B	4.40±0.44	4.01±0.60	4.20±0.54	4.6±0.60	4.30±0.53
C	4.50±0.70	4.20±09	4.70±0.80	4.70±0.70	4.80±0.60
LSD	0.42	0.24	0.56	1.462	0.04

Product A-(100% wheat flour); Product B-(50% wheat and 50% millet flour); Product C-(70% wheat and 30% millet flour)

Colour is a sensory quality that consumers discover in purchasing new products due to its visual appeal. The colour of the pasta samples ranged from 4.40-4.80% with the control sample A (100% wheat flour) having a high mean score while the least mean score was sample B (50% wheat flour and 50% millet flour). There was a significant ($p<0.05$) difference between the composite sample C (70% wheat flour and 30% millet flour) and the control (100% wheat flour). This colour difference could be attributed to the whole wheat flour used in the preparation of the pasta. The composite sample C (70% wheat flour and 30% millet flour) had the highest mean score of 4.20 for texture. However, at $P < 0.05$ level of probability revealed that there was no significant difference between the control sample (100% wheat flour pasta) and the composite. This implies that, pasta produced from composite flours have its hardness very satisfactory.

The aroma of the pasta products ranged from 4.20±0.54 to 4.70±0.80. The composite pasta sample C (70% wheat flour and 30% millet flour) had the highest mean score of 4.70% followed by sample A (100% wheat flour) with a mean score of 4.20% and Sample B ((50% wheat flour and 50% millet flour)) had the lowest mean score rating 4.20%. It was observed from the result that there was a significant ($p>0.05$) between the composite samples and the control as 30% of the millet flour was incorporated. The taste of the pasta samples ranged from 4.50-4.70% with the highest mean score being sample C (70% wheat flour and 30% millet flour). However, there was no significant ($p<0.05$) different between the composite samples and the control. The quality of the pasta (Aroma, colour, texture and taste) had influence the overall acceptability of the pasta. There was a significant ($p<0.05$) difference between all fortified samples and the control sample. Sample C (70% wheat flour and 30% millet flour) had the highest mean score (4.80%) followed by sample A (100% wheat flour) with 4.50%. Sample C was the most accepted followed by samples A.

Table 3: Results for proximate analysis

Products	**Moisture%**	**Ash%**	**Fat%**	**Protein%**	**Carbohydrate%**
Product A	10.17±0.0024	1.55±0.0293	37.40±1.0879	14.36±0.0405	36.55±1.0156
Product B	10.56±0.5073	1.54±0.0231	34.96±0.8242	14.64±0.1992	38.28±0.5392
Product C	9.02±0.2642	1.46±0.0012	35.74±0.0003	13.80±0.1694	39.98±0.4344

Source: field survey (2019)
Product A-(100% wheat flour); Product B-(50% wheat and 50% millet flour); Product C-(30% wheat and 70% millet flour)

The moisture contents of Product C and B is ranged of 9.02 to 10.56%. The control had a moisture content of 10.17. Product (B and C) have a content of 10.56% and 9.02% respectively. The high moisture content has been associated with short shelf life of composite millet flour as they encourage microbial proliferation that lead to spoilage [31].

The ash content of the spaghetti increased from 1.4591 to 1.5548% with increase in the product B and A. The increase in the ash content can be as a result of millet blends. The increase in the ash content could make the product a good source of minerals as observed by other researchers [32].

The fat content also increased from 34.9850% to 37.3645% in the composite millet flour spaghetti produced from millet flour. Product (A) had the highest fat (37.36%) content due to the 100% increase in the wheat flour. The control Product (C) had fat content of 35.74% while Product (B) had the lowest fat (34.98%). The high fat content of the composite wheat flour can affect the shelf stability of the product [33]; [34]. The protein content of the control is 14.36% and that for Product B and C is 14.64% and 13.7983% respectively. The decrease is as a result of substitution of wheat flour (100%) with the millet flour of (70%). The protein level can be improved by increasing the content of the millet flour. The carbohydrate content were low in Product A (36.55%) and Product B (38.28%). Product C had the highest content of 39.98%. The high carbohydrate was as a result of incorporating the millet flour 70% and wheat flour of 30%.

CONCLUSION

The study has shown the possibility of using wheat and millet flour for the production of pasta with required sensory properties and significant nutrient density. The replacement of wheat with 30% millet flour resulted in superior proximate and sensory attributes. This means that pasta can be prepared using millet flour up to 30% without an adverse effect on the nutritional and sensory attributes.

REFERENCES

[1] Okpala, L. C. , & Egwu, P. N. (2015). Utilization of broken rice and cocoyam flour blends in the production of biscuits. Nigerian Food Journal, 33(1), 8–11.
[2] (Ibitoye, Afolabi, Otegnayo, and Akintola, 2013)
[3] Nwanekezi, E. C. (2013). Composite flours of baked products and possible challenges. Nigerian Food Journal, 31(2), 8–17. 10.1016/S0189-7241(15)30071-0
[4] Olaoye OA, Onilude AA, Idowu OA (2006). Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans. Afr. J. Biotechnol. 5 (11): 1102-1106.
[5] (Lionetti, Gatti, Pulvirenti, and Catassi, 2015)
[6] Ocheme, O. B. , Oloyede, O. O. , & Mahmud, A. H. (2010). Production and evaluation of bread using blends of wheat flour and fermented plantain flour. Nigerian Food Journal, 28(2), 284–293.

[7] Ade, I. C. , Ingbian, E. K. , & Abu, J. O. (2012). Physical, chemical and sensory properties of baked products from blends of wheat and African yam bean water-extractable proteins. Nigerian Food Journal, 30(1), 109–115. 10.1016/S0189-7241(15)30019-9

[8] Adegunwa, M. O. , Bakare, H. A. , & Akinola, O. F. (2012). Enrichment of noodles with soy flour and carrot powder. Nigerian Food Journal, 30(1), 109–115

[9] Olapade, A. A. , & Oluwole, O. B. (2013). Bread making potential of composite flour of wheat-Acha enriched with cowpea flour. Nigerian Food Journal, 31(1), 6–12. 10.1016/S0189-7241(15)30050-

[10] Ugwuona, F. U. , & Suwaba, S. (2013). Effects of defatted jack bean flour and jack bean protein concentrate on physicochemical and sensory properties of bread. Nigerian Food Journal, 31(2), 25–32. 10.1016/S0189-7241(15)30073-4

[11] Ibitoye, W. O. , Afolabi, M. O. , Otegnayo, B. O. , & Akintola, A. C. (2013). Preliminary studies of the chemical composition and sensory properties of sweet potato starch-wheat flour blend noodles. Nigerian Food Journal, 31(2), 48–51.

[12] Gomes, P. C., Rodrigues, M. P., Albino, L. F. T., Rostagno, H. S., Gomes, M. F. M., Mello, H. H. C., & Brumano, G. (2008). Determinação da composição química e energética do milheto e sua utilização em rações para frangos de corte de 1 a 21 dias de idade. Revista Brasileira de Zootecnia, 37(9), 1617-1621. http://dx.doi.org/10.1590/S1516-35982008000900013.

[14] Krishnan, R., Dharmaraj, U., Sai Manohar, R., & Malleshi, N. G. (2011). Quality characteristics of biscuits prepared from finger millet seed coat based composite flour. Food Chemistry, 129(2), 499-506. http://dx.doi.org/10.1016/j.foodchem.2011.04.107

[15] Dykes, L., & Rooney, L. W. (2006). Review: sorghum and millet phenols and antioxidants. Journal of Cereal Science, 44(3), 236-251. http://dx.doi.org/10.1016/j.jcs.2006.06.007

[16] Lakshmi Kumari, P., & Sumathi, S. (2002). Effect of consumption of finger millet on hyperglycemia in non-insulin dependent diabetes mellitus (NIDDM) subjects. Plant Foods for Human Nutrition, 57(3-4), 205-213. http://dx.doi.org/10.1023/A:1021805028738

[17] Chethan, S., & Malleshi, N. G. (2007). Finger millet polyphenols: characterization and their nutraceutical potential. American Journal of Food Technology, 2(7), 582-592.

[18] Singh, K. P., Mishra, H. N., & Saha, S. (2010). Moisture-dependent properties of barnyard millet grain and kernel. Journal of Food Engineering, 96(4), 598-606.

[19] Suma, P. F., & Urooj, A. (2014). Nutrients, antinutrients & bioaccessible mineral content (in vitro) of pearl millet as influenced by milling. Journal Food Science and Technology, 51(4), 756-761

[20] Rathi, A., Kawatra, A., & Sehgal, S. (2004). Influence of depigmentation of pearl millet (L.) on sensory attributes, nutrient composition, in vitro protein and starch digestibility of pasta. *Pennisetum glaucum*Food Chemistry, 85(2), 275-280.

[21] Saha, S., Gupta, A., Singh, S. R. K., Bharti, N., Singh, K. P., Mahajan, V., & Gupta, H. S. (2011). Compositional and varietal influence of finger millet flour on rheological properties of dough and quality of biscuit. LWT - Food Science and Technology, 44(3), 616-621.

[22] Schoenlechner, R., Szatmari, M., Bagdi, A., & Tömösközi, S. (2013). Optimization of bread quality produced from wheat and proso millet (. *Panicum miliaceum* L.) by adding emulsifiers, transglutaminase and xylanaseLWT - Food Science and Technology, 51(1), 361-366.

[23] David, A. and Bender, H. (2006). Bender' Dictionary of Nutrition and Food Technology (8 th ed.), Woodhead Publishing Ltd., Cambridge, England

[24] Leszek, M. (2011). Extrusion-Cooking Techniques Applications, Theory and Sustainability. WILEY-VCH Verlag & Co. K Ga A, Weinheim, Germany

[25] (Siebel, W. 2011. Future of flours – composite flours. Downloaded from www.muehlenchemie.de/ downloads-future-of-flours/fof_kap_16.pdfon 3/12/2011

[26] F. A. Fiorda, M. S. Soares Jr., F. A. da Silva, M. V. Grosmann, and L. R. Souto, "Microstructure, texture and colour of gluten-free pasta made with amaranth flour, cassava starch and cassava bagasse," *LWT-Food Science and Technology*, vol. 54, no. 1, pp. 132–138, 2013.

[27] Caperuto, L., Amaya-Farfan, J., & Camargo, C. R. O. (2001). Performance of quinoa
(Chenopodium quinoa Willd) flour in the manufacture of gluten-free spaghetti. Journal of the Science of Food and Agriculture, 81(1), 95-101.

[28] Alamprese, C., Casiraghi, E., & Pagani, M. A. (2007). Development of gluten free fresh egg Pasta analogues containing buckwheat. European Food Research, 225(2), 205-213.http://dx.doi.org/10.1007/ s00217-006-0405-y.

[29] Welsby D.A and Martland R.E(1993). Basic Cookery, 3rd ed. Scotprint ltd, Musselburgh, great Britain.

[30] A.O.A.C. (2012). Association of Official Analytical Chemist (16th ed.),Washington DC, USA

[31] Mridula D, Singh KK, Barnwal P. 2011. Development of omega-3 rich energy bar with flaxseed. *J Food Sci Technol* 50: 950–957. Doi: 10.1007/s13197-011-0425-x

[32] De-Noni, I., & Pagani, M. A. (2010). Cooking properties and heat damage of dried pasta as
influenced by raw material characteristics and processing conditions. Critical Reviews in Food Science and Nutrition, 50(5), 465-472. http://dx.doi.org/10.1080/ 10408390802437154. PMid:20373190.

[33] Weiss EA (2000). Oilseed Crops. 2nd ed. Blackwell Science Ltd. Victoria, Australia, pp. 165-203.

[34] Potter N, Hotchkiss J (2006). Food Science. 5th ed. CBS Publishers and distributors. Daryangaji, New Delhi, India