IJPPHT
e ISSN-2231-6426
Volume 6 | Issue 1 | June, 2015 | 80-86
Visit us: *www.researchjournal.co.in*
International Journal of Processing and Post Harvest Technology
RESEARCH PAPER
DOI: 10.15740/HAS/IJPPHT/6.1/80-86

Application and effect of addition of popped makhana flour on the properties and qualities of cookies

SANDEEP KUMAR*, INDERJEET SINGH, NITIN KUMAR[1] AND CHARANJIV SINGH
Department of Food Engineering and Technology, Sant Longowal Institute of Engineering and Technology, Longowal, SANGRUR (PUNJAB) INDIA
Email : sandeepfoodeng@gmail.com
[1]Department of Food Engineering, National Institute of Food Technology Entrepreneurship and Management, SONIPAT (HARYANA) INDIA
*Author for Correspondence

Research chronicle : Received : 18.12.2014; **Revised :** 01.05.2015; **Accepted :** 13.05.2015

SUMMARY :

Substitution of wheat flours with non-wheat flours has received considerable attention in recent years due to their positive health benefits. The influence of blending (5-25 %) of popped makhana flour and wheat flour on the physico-chemical, textural and sensory qualities of cookie made from popped makhana-wheat flour blend was investigated. The physico-chemical characteristics of cookies were evaluated in terms of proximate composition and energy value. Physical properties were in terms of cookie diameter, thickness, spread ratio, colour and cookie breaking strength (texture). The cookie sensory qualities were evaluated in terms of texture, mouthfeel, taste, colour and overall acceptability. Increase in the popped makhana flour proportion increased the moisture and protein content of the cookies and resulted in a decrease in the fat, ash content, crude fibre, carbohydrates and energy value of the cookie. Breaking strength of the cookies significantly ($p<0.05$) increased whereas cookie diameter and spread ratio significantly decreased with an increase in popped makhana flour proportion. On the other hand, increase in weight and thickness was observed with increase in proportion of popped makhana flour. The colour value in terms of L*, a* and b* also decreased and increase in colour difference was observed. The sensory quality scores of cookie decreased significantly with increase in popped makhana flour proportion. The results of overall acceptability confirmed that replacing of wheat flour with popped makhana flour up to 25 per cent for cookie baking was fairly acceptable by the sensory panelist.

KEY WORDS : Cookies, Makhana, Popped makhana flour

How to cite this paper : Kumar, Sandeep, Singh, Inderjeet, Kumar, Nitin and Singh, Charanjiv (2015). Application and effect of addition of popped makhana flour on the properties and qualities of cookies. *Internat. J. Proc. & Post Harvest Technol.,* **6** (1) : 80-86.

Euryale ferox is known as makhana in India and is an important aquatic crop (Jha, 1968; Jha *et al.*, 1991). In India it is mainly cultivated in the states of Bihar and some parts of eastern India (Mishra *et al.*, 2003). Makhana is stored in two forms *i.e.* seeds and popped makhana. Despite its nutritional and health

importance, makhana has not gained much research attention due to less awareness among the researchers (Zhang, 2010; Zhang *et al.*, 2011b and Jha *et al.*, 1991). The nutritional values of popped makhana were also reported by several researchers (Boyd, 1968; Jha, 1968 and Jha *et al.*, 1991) but different properties of makhana flour were not reported till date. Makhana is graded into 4 to 5 grades based on size and light weight. Lower grade like murra and thurri are being sold at very low prices. It constitute about 15-20 per cent of the total popped makhana production. Lower grades of makhana can be converted into powder or flour form and sold for preparation of bakery or other products. Popped makhana flour may possibly serve as a useful alternative in nutritious food products and could improve the physico-chemical, functional and sensory characteristics of products.

Replacement of part of wheat flour with non-wheat ingredients such as barley, sorghum, millet, oatmeal and multi-grain mixtures for the production of cookies and baked products had been reported by various researchers (Sammy *et al.*, 1970). Cookie is a baked flour confectionery dried down to low moisture content (Bender, 1999). It is principal food throughout the world which gives more nutrients than any other single food source (Bhatia *et al.*, 1980). Cookie is mainly made from cereals, sweeteners, shortenings and leavening agents. Wheat is the most widely used cereals for cookie making in that it provides necessary gluten to the biscuit structure.

Despite the research efforts in developing new verities and analyzing the nutritional content, limited research is done to utilize the potential of makhana to produce value-added products. Studying the possibilities of increasing makhana utilization as an important food is the basis of this research which tries to find alternative ways in which makhana can be more accepted not only as a traditionally processed food but also as a value added product in India. Therefore, this study is initiated to study the possibility of incorporating popped makhana flour (5-25 %) in cookie formulation and examine the proximate, physical, colour, textural and sensory properties of cookies.

EXPERIMENTAL METHODS

Materials :

Wheat flour was purchased from local market in Sangrur, Punjab (India). Popped makhana were purchased from Darbhanga, Bihar. The popped makhana was grounded into fine powder, and then mixed with wheat flour at different proportion (0:100, 05:95, 10:90, 15:85, 20:80 and 25:75) of popped gorgon nut and wheat flour, respectively.

Product development :

The cookies was prepared with combinations of 75:25, 80:20, 85:15, 90:10, 95:5 and 100:0 of (Wheat flour: Popped makhana flour), respectively.

Cookie preparation procedure :

Cookies were prepared using wheat flour and popped gorgon nut composite flour with different ingredients by micro wire-cut formulation AACC (2000) method number 10-54.

Amount of flour and water were adjusted depending on flour moisture content according to AACC (2000) Approved method number 10-54.

Table A : Proportions of various ingredients used in cookie preparation

Ingredients	Weight (g)	Percentage (%)
Flour (WF and PMF)	100[a]	48.38
Sucrose	42	20.07
All-purpose shortening	40	19.11
High- fructose corn syrup	1.5	0.71
Nonfat dry milk	1	0.47
NaCl	1.25	0.59
Sodium bicarbonate	1	0.47
Ammonium bicarbonate	0.5	0.23
Deionized water (variable)	20.75[b]	9.91

[a] Method 10-54 assumes 13 per cent water content for flours; [b] Deionized water (g) = (40 –g flour) + 8.8 for 40 g of flour

The various steps involved in the preparation of cookies were as the following :

For each experiment 100 g of mixed flour was taken. Other ingredients were weighed accordingly. Weighted amount of dry ingredients were transferred into jar. Dry ingredients were mixed by tumbling jar 20 times. Appropriate amount of shortening was weighed into mixing bowl. Dry ingredients were added on top of the shortening, mixed in Howart mixer on speed 1 for 3 min, scraped every minute. Scraped creamed mass was transferred into cake dough mixing bowl. Weighed HFCS were transferred into 100 ml beaker. Appropriate amount of water was added and swirled. Weighed amount of ammonium bicarbonate was added to HFCS-water mixture and swirled to dissolve. Liquid was added to creamed mass and mixed for 1 min, scraped every 15 seconds. Calculated amount of flour was added and mixed for 10 sec while tapping side of bowl. Dough was scraped from mixer and bowl pins, outer edge and bottom of bowl were scraped pushing dough between pins several times. Mixed for 10 sec, scraped, mixed for 10 sec. Dough was scraped gently from bowl. The dough was sheeted to thickness of 6 mm. The sheeted dough was made into circular piece by cookie cutter of 50 mm diameter. The circular dough piece was then placed on a tray which was covered by butter paper or greased surface and immediately placed in baking oven (Continental, India) at 205 ± 5°C for 11 minutes. On removal from oven, it was cooled for 5 minutes and cookies were removed from baking sheet. Baking sheet was wiped with damp towel to remove grease. It was washed in warm, water, dried thoroughly, and allowed to come to room temperature before next use. Cookies after baking were cooled to room temperature for 30 min, packed in sealed plastic bags and kept in an air tight container in a room at ambient temperature.

Proximate analysis of cookies :

Moisture, protein, ash, fat and crude fibre of cookies prepared with different proportion of makhana and wheat flour were quantified according to AOAC (2000). Carbohydrates were determined by difference method (Raghuramula *et al.*, 1983). Energy value was determined by using formula methods (Paul and Southgate, 1978).

Physical analysis of cookies :

For the determination of weight, width (diameter), thickness and spread ratio and spread factor following methods of AACC (2000) approved method 10-50D were followed.

Cookie weight :

The weight of cookies after baking was determined by using electronic balance and mean value was expressed (g).

Cookie width (diameter) :

After cooling for 30 min, to determine the width (W), cookies were laid edge to edge and the width of six cookies was measured by using a scale or vernier caliper. The cookies were rotated through 90° and re-measured. To obtain average width (W) of six cookies, mean of all measurements was taken and divided by six. The average width was reported in cm.

Cookie thickness :

To determine the thickness (T), six cookies were stacked on top of one another. The total height was measured in millimeters with the help of vernier caliper. By restacking them in different orders, an average of three readings were recorded and divided by six to give cookie thickness in cm.

Cookie spread ratio :

Cookie spread was determined from width and thickness, by using following formula :

$$\textbf{Spread ratio } Z \frac{W}{T}$$

where,

W is the width/diameter of cookies and T is the thickness of cookies in mm.

Colour measurement :

Colour of cookie samples was determined using the Hunter lab Colour Spectrophotometer (Gretag Macbeth, I 5, USA). The instrument was calibrated using a standard white and black plate. The samples were placed against the light source for measurement. In the hunter scale, L* varies from 0 (darkness) to 100 (Lightness). a* varies from positive + a* (red) to - a* (green), whereas, b* varies from positive + b* (yellow) to - b* (blue). Three readings were taken from each cookie type and per batch and the average value was reported.

The instrument was calibrated against a standard

white colour reference tile (L_s = 97.36, a_s = - 0.74, b_s = - 0.25). Total colour difference (ΔE) was calculated by applying the equation :

$$\Delta E = \sqrt{(L_s - L^*)^2 + (a_s - L^*)^2 + (b_s + L^*)^2}$$

Fracture strength (snap test) :

The breaking strength of cookies was measured by the bend/snap (also called three-point break) technique (Gains, 1991) using a three-point bending rig attached to Texture Analyzer (TA.×T_2, Stable Microsystems, Surrey, UK). Two beams (8.8 cm long, 3.0 cm high) were spaced vertically at 40 mm distance apart on a horizontal plane. The cutting beam (8.8 cm long, 3.2 cm high) was attached to an Instron. The test was performed by supporting a cookie across the two beams and driving the upper beam down until the sample snapped. The test was performed under measure of the hardness and resistance of cookies to bend or snap. The snap test was conducted after 24 hours after storage. Three break tests were conducted on each cookies type or batch and the average value was reported. This test simulates the evaluation of hardness by consumer holding the cookie in hands and breaking the same by bending.

Sensory analysis of the cookies :

The cookies were evaluated by a panel consisting of 10 semi trained members consisting of M.Tech students of the Department of Food Engineering and Technology, SLIET, Longowal, Sangrur (India) on the basis of texture, mouthfeel, taste, colour and overall acceptability. Coded samples of cookies were served on a white disposable plastic tray and distilled water was provided for rinsing the mouth with sensory assessment sheet to evaluate the cookies.

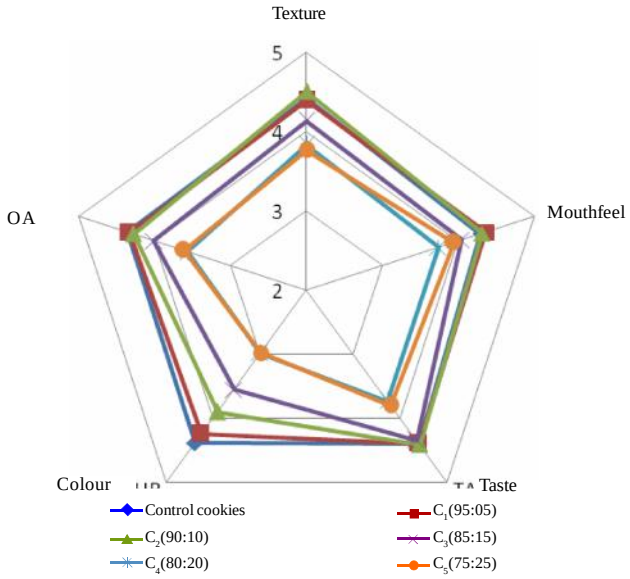

Fig. 1 : Sensory analysis chart of cookies

Stastical analysis :

All the experiments were carried out in triplicate and results were represented as mean ± SD. The significance of differences among the values was determined using one way analysis of variance (ANOVA) followed by Duncan's multiple-range test (Duncan, 1955). STATISTICA 7 (Stat Soft, Tusla, USA) statistical software packages ($p<0.05$) was used to determine which means are significantly different.

EXPERIMENTAL FINDINGS AND ANALYSIS

The findings of the present study as well as relevant discussion have been presented under following heads :

Proximate analysis of cookies :

The proximate analysis of cookies prepared from

Table 1 : Proximate analysis of popped makhana flour substituted cookies

Parameters	Control cookies	$C_{1\ (95:5)}$	$C_{2\ (90:10)}$	$C_{3\ (85:15)}$	$C_{4\ (80:20)}$	$C_{5\ (75:25)}$
Moisture (%)	1.53^{c}±0.11	1.47^{c}±0.12	1.73^{bc}±0.11	2.00^{ab}±0.20	2.13^{a}±0.23	2.33^{a}±0.30
Protein (%)	6.00^{a} ± 0.10	5.95^{b} ± 0.17	6.18^{a} ± 0.20	6.12^{a} ± 0.30	6.30^{a} ± 0.17	6.35^{a} ± 0.26
Fat (%)	20.28^{a} ± 0.16	19.81^{bc} ± 0.10	19.97^{b} ± 0.10	19.76^{cd} ± 0.14	19.58^{d} ± 0.04	19.57^{d} ± 0.05
Ash (%)	0.76^{a} ± 0.04	0.79^{a} ± 0.02	0.79^{a} ± 0.02	0.67^{b} ± 0.02	0.66^{b} ± 0.02	0.65^{b} ± 0.03
Crude fibre (%)	0.79^{a} ± 0.10	0.84^{a} ± 0.05	0.77^{a} ± 0.11	0.74^{a} ± 0.07	0.77^{a} ± 0.09	0.73^{a} ± 0.13
Carbohydrate[1] (%)	70.60^{a} ± 0.12	71.13^{a} ± 0.18	70.54^{a} ± 0.49	70.69^{a} ± 0.19	70.49^{a} ± 0.31	70.34^{b} ± 0.55
Energy value[2] (KJ/100 g)	2073.37^{a} ± 2.68	2063.19^{b} ± 3.26	2063.41^{b} ± 1.56	2056.89^{b} ± 4.91	2049.83^{c} ± 4.17	2047.74^{c} ± 5.66

Mean ± S.D. with different superscripts in a row differ significantly ($p<0.05$) (n=3); [1]Carbohydrate by difference method; [2]Energy value by theoretical method.

composite flour is presented in Table 1. The moisture content of composite cookies at different proportion of popped makhana flour ranged from 1.47 per cent to 2.33 per cent. A high level of moisture content may indicate short shelf-life of composite cookies as they encourage microbial growth which leads to spoilage. The protein content of the cookies increased slightly with the increase in supplementation from 5 per cent to 25 per cent of popped makhana flour. The mean value of protein content of the composite wheat blend cookie ranged from 5.95 per cent to 6.35 per cent. In the present study, the protein content of the cookie developed from wheat flour (control cookie) was found to be 6.00 per cent. The fat content of the composite cookies was found to be 19.57 per cent to 19.97 per cent. The fat content of control cookies was found to be 20.28 per cent. The added fat during preparation of cookies was kept constant. The ash content of cookie containing popped makhana flour was lower than that of the control sample. The composite cookie samples contained ash ranging from 0.65 per cent to 0.79 per cent. Crude fibre is represented by an insoluble but combustible organic residue. The crude fibre content of cookie containing popped makhana flour cookie was slightly lower than of the control cookie. The carbohydrate content of control cookies was found to be 70.60 per cent. The carbohydrate content depends on the all proximate composition of the cookies. The difference in the result was due the other proximate compositions of cookies. The energy value of control cookies (wheat flour) was observed as 2073.37 kJ/100 g. The energy values of the composite wheat flour cookies ranged from 2063.19 to 2047.74 kJ/ 100 g. It was observed that energy value decreased gradually with increase of composite flour blend.

Physical analysis of composite flour cookies :

Physical characteristics of the cookies including weight, diameter, thickness and spread ratio are presented in Table 2.

Weight of cookies :

The weight of the popped makhana flour composite cookies ranged from 12.04g to 13.36g *i.e.* from 5 per cent to 25 per cent. As the substitution of popped makhana flour increased, the weight of cookies also increased. This may be due to the fact that popped makhana flour has higher water and oil absorption capacity than the wheat flour.

Diameter of cookies :

The diameter of composite cookies with different level of popped makhana nut flour ranged between 5.13 cm to 5.42 cm. As the substitution of popped makhana flour increased in the blends, the diameter decreased gradually. The diameter of control wheat cookies was reported as 5.39 cm. This may be due to higher water absorption capacity of the blend is associated with a decrease in the width of the cookies sample. Baljeet *et al.* (2010) have also reported the decrease in diameter of wheat cookies on substitution of different level of buckwheat flour.

Thickness of cookies :

Thickness is one of the quality parameter for cookie. Thickness of the composite cookies increased with increase in substitution level from 0.93 cm to 1.13 cm *i.e.* from 5 per cent to 25 per cent. The thickness of control wheat cookies was reported as 0.95 cm. As the substitution of popped makhana flour increased in the blends, the thickness of cookies increased. Increase in thickness may be due to the decrease in diameter. Baljeet *et al.* (2010) have also reported the increase in diameter of wheat cookies on substitution of different level of buckwheat flour.

Spread ratio of cookies :

The spread ratio was higher for cookies made from control and decreased with increasing the proportion of

Table 2 : Physical characteristics of popped makhana flour substituted cookies

Parameters	Wheat flour	$C_{1\ (95:5)}$	$C_{2\ (90:10)}$	$C_{3\ (85:15)}$	$C_{4\ (80:20)}$	$C_{5\ (75:25)}$
Weight (g)	$12.72^{ab} \pm 0.51$	$12.04^{c} \pm 0.48$	$12.39^{bc} \pm 0.44$	$13.22^{a} \pm 0.15$	$13.07^{a} \pm 0.08$	$13.36^{a} \pm 0.13$
Diameter (cm)	$5.39^{a} \pm 0.08$	$5.42^{a} \pm 0.04$	$5.28^{b} \pm 0.02$	$5.23^{b} \pm 0.02$	$5.13^{c} \pm 0.03$	$5.14^{c} \pm 0.05$
Thickness (cm)	$0.95^{b} \pm 0.02$	$0.93^{b} \pm 0.02$	$0.95^{b} \pm 0.05$	$1.06^{a} \pm 0.05$	$1.08^{a} \pm 0.02$	$1.13^{a} \pm 0.05$
Spread ratio	$5.64^{a} \pm 0.20$	$5.81^{a} \pm 0.20$	$5.57^{a} \pm 0.31$	$5.07^{b} \pm 0.29$	$4.74^{bc} \pm 0.14$	$4.54^{c} \pm 0.18$
Hardness (kg)	$2.49^{b} \pm 0.20$	$2.11^{c} \pm 0.26$	$2.65^{b} \pm 0.09$	$2.82^{b} \pm 0.10$	$3.32^{a} \pm 0.21$	$3.65^{a} \pm 0.27$

Mean ± S.D. with different superscripts in a row differ significantly ($p<0.05$) (n=3)

popped makhana flour. The spread ratio of the composite cookies ranged from 4.54 to 5.81. The result showed that there was decrease in the spread ratio as the proportion of popped makhana flour increased in the composite flour. The spread ratio of control wheat cookies was reported as 5.64. Spread ratio is affected by the competition of ingredients for available water (Claughton and Pearce, 1989).Similar trend was also reported by Baljeet *et al.* (2010) of wheat cookies on substitution of different level of buckwheat flour.

Hardness of cookies :

In the control cookies, hardness was observed as 2.49 kg The hardness of cookies increased with increase in popped makhana flour supplementation. The hardness of the composite cookies ranges from 2.11 kg to 3.65 kg *i.e.* from 5 per cent to 25 per cent. This may be due to the increase in the thickness of composite cookies. We *et al.* (2011) have also reported the increase in hardness of cookies on addition of extruded rice flour at different proportions when compared with wheat cookies.

Colour characteristics of cookies :

The colour of the food products is the first attribute that affects the decision of consumer for purchasing or consuming any food products. Mean values for Hunter colour values of different proportions of popped makhana flour-wheat flour blends cookie along with control (wheat flour) cookies are shown in Table 3.

Lightness (L*) shows the whiteness of product. The L* value decreased with increase in the percentage of popped makhana flour in the wheat flour. The L* of the different proportion of popped makhana composite cookies ranges from 57.32 to 62.51. The L* of the control wheat cookies was reported as 63.64. a*+ value give the redness and a*- value gives the greenness character of product. As the substitution of popped makhana flour increased in the blend, the decrease in the a* value was reported. The a* of the different proportions of popped makhana composite cookies ranged from 11.34 to 14.43. b*+ value give the yellowness and b*- value gives the blueness of the product. As the substitution of popped makhana flour increased in the blend, the decrease in the b* value was reported. The b* value of the different proportions of popped makhana composite cookies ranged from 22.10 to 28.52. The b* value of the control wheat cookies was reported as 29.46. The total colour difference (ΔE) of all the cookies sample were reported with reference with standard white tile. ΔE of the different proportions of popped makhana composite cookies ranged from 37.59 to 41.81.

Sensory analysis of control and composite flour cookies :

The sensory evaluation is very important criterion for determination of the overall acceptability of food materials. Results of the sensory evaluation of control cookies and popped makhana flour substituted at different levels from 5 per cent to 25 per cent and was determined on the basis of texture, mouthfeel, taste, colour and overall acceptability as presented in Table 4. The sensory scores for the texture and taste were highest in cookies made by 10 per cent substitution of wheat flour with gorgon nut flour. The scores were even higher than the scores given to control (wheat flour) cookies. The scores for

Table 3 : Colour characteristics of popped makhana flour substituted cookies

Parameters	Control	$C_{1\ (95:5)}$	$C_{2(90:10)}$	$C_{3(85:15)}$	$C_{4(80:20)}$	$C_{5(75:25)}$
L*	$63.64^{a} \pm 0.46$	$62.51^{b} \pm 0.87$	$62.02^{b} \pm 0.55$	$59.60^{c} \pm 0.88$	$57.32^{d} \pm 0.21$	$57.43^{d} \pm 0.10$
a*	$15.74^{a} \pm 0.31$	$14.43^{b} \pm 0.03$	$13.06^{c} \pm 0.09$	$12.44^{d} \pm 0.07$	$12.22^{d} \pm 0.19$	$11.34^{e} \pm 0.06$
b*	$29.46^{a} \pm 0.18$	$28.52^{a} \pm 0.38$	$25.52^{b} \pm 0.29$	$24.23^{c} \pm 0.70$	$22.45^{d} \pm 0.94$	$22.10^{d} \pm 0.41$
ΔE	$37.17^{c} \pm 0.28$	$37.66^{c} \pm 0.82$	$37.59^{c} \pm 0.55$	$39.68^{b} \pm 0.85$	$41.81^{a} \pm 0.27$	$41.44^{a} \pm 0.12$

Mean ± S.D. with different superscripts in a row differ significantly ($p<0.05$) (n=3)

Table 4 : Sensory analysis of popped gorgon nut flour substituted cookies

Parameters	Control	$C_{1\ (95:5)}$	$C_{2(90:10)}$	$C_{3(85:15)}$	$C_{4(80:20)}$	$C_{5(75:25)}$
Texture	$4.41^{ab} \pm 0.38$	$4.39^{ab} \pm 0.20$	$4.5^{a} \pm 0.11$	$4.13^{bc} \pm 0.43$	$3.83^{cd} \pm 0.47$	$3.76^{d} \pm 0.40$
Mouth feel	$4.29^{a} \pm 0.20$	$4.36^{a} \pm 0.20$	$4.31^{a} \pm 0.28$	$4.04^{ab} \pm 0.30$	$3.74^{b} \pm 0.51$	$3.94^{b} \pm 0.47$
Taste	$4.39^{a} \pm 0.18$	$4.39^{a} \pm 0.17$	$4.41^{a} \pm 0.19$	$4.34^{a} \pm 0.16$	$3.73^{b} \pm 0.30$	$3.8^{b} \pm 0.50$
Colour	$4.38^{a} \pm 0.34$	$4.24^{a} \pm 0.43$	$3.9^{b} \pm 0.35$	$3.55^{c} \pm 0.35$	$2.99^{d} \pm 0.13$	$2.98^{d} \pm 0.26$
Overall acceptability	$4.36^{a} \pm 0.12$	$4.34^{a} \pm 0.21$	$4.28^{a} \pm 0.11$	$4.01^{b} \pm 0.18$	$3.57^{c} \pm 0.24$	$3.62^{c} \pm 0.28$

Mean ± S.D. with different superscripts in a row differ significantly ($p<0.05$) (n=10)

the mouthfeel and colour were maximum for cookies made by substituting wheat flour with 5 per cent gorgon nut flour. Overall acceptability scores were also maximum for cookies made by 5 per cent substitution.

LITERATURE CITED

A.A.C.C. (2000). *Approved methods of American association of cereal chemists*, 10th Ed. American Association of Cereal Chemist Inc., St. Paul, Minnesota.

A.O.A.C. (2000). *Official methods of analysis*. Association of Analytical Chemists, 17th Ed. Alinton, VIRGINIA, USA.

Bhatia, S.C., Arora, S.M. and Kumar, S.R. (1980). *Hand Book on food industries*, DELHI , INDIA.

Baljeet, S.Y., Ritika, B.Y. and Roshan, L.Y. (2010). Studies on functional properties and incorporation of buckwheat flour for biscuit making. *Internat. Food Res. J.*, **17**: 1067-1076.

Bender, A.E. (1999). *Benders' Dictionary of nutrition and food technology*, Cambridge, Woodhead Publishing Limited, England. 56pp.

Boyd, C.E. (1968). Fresh water plants: a potential source of protein. *Econ. Bot.,* **22** (4) : 359-368.

Claughton, S.M. and Pearce, R.J. (1989). Protein enrichment of sugar-snap cookies with sunflower protein isolates. *J. Food Sci.*, **54** (2) : 354-358.

Duncan, D.B. (1955). Multiple range and multiple F-tests. *Biometrics*, **11** (1) : 1-42.

Gains, C.S. (1991). Instrumental measurement of hardness of cookies and crackers. *Cereal Foods World*, **36** (12) : 989-996.

Jha, U.N. (1968). The pond ecosystem. Ph.D. Thesis, Banaras Hindu University, Varanasi, U.P. (INDIA).

Jha, V., Barat, G.K. and Jha, U.N. (1991). A nutritional evaluation of *Euryale ferox* Salisb (makhana). *J. Food Sci. & Technol.*, **8** (5) : 326-328.

Mishra, R.K., Jha, V. and Dehadrai, P.V. (2003). *Makhana*. Directorate of Information and Publications of Agriculture, ndian Council of Agricultural Research, NEW DELHI, INDIA.

Paul, A.A. and Southgate, D.A.T. (1978). *The composition of foods.* McCance and Widdowson's (4th Ed.), H.M. Stationery Office, LONDON, UNITED KINGDOM.

Raghuramula, N., Nair, K.M. and Kalyanasundaram, S. (1983). *Food analysis.* In: *A Manual of Laboratory Techniques.* National Institute of Nutrition, Indian Council of Medical Research, Hyderabad (A.P.) INDIA .

Sammy, G.M. (1970). Studies in composite flours. I. The use of sweet potato flour in bread and pastry making. *Tropical Agric.*, (*Trinidad*), **47** (2) : 115-125.

We, G.J., Lee, I., Kang, T.Y., Min, J.H, Kang, W.S. and Ko, S. (2011). Physico-chemical properties of extruded rice flours and a wheat flour substitute for cookie application. *Food Engg. Prog.*, **15** (4): 404-412.

Zhang, S. (2010). Analysis on the nutrient components of *Euryale ferox* Salisb. *J. Anhui Agric. Sci.*, **33**: 151.

Zhang, S., Cheng, H. and Dong, J. (2011). Amino-acid and mineral composition of the seeds of *Euryale ferox*. *Chemistry. Natural Compounds*, **47** (3).