RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL
e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 6 | Issue 2 | October, 2015 | 207-214
DOI : 10.15740/HAS/FSRJ/6.2/207-214

Physical and sensory attributes of fibre enriched cookies

K. SUMA AND P.V. NANDINI

The study was designed to formulate fibre enriched cookies that contains sufficient nutrient (protein and fibre). The objectives of this research were to prepare fibre enriched cookies supplemented with rice bran and wheat bran at different proportion (10 to 50 %) and to assess their physical and sensory properties. Fibre enriched cookies were developed by incorporating rice bran, wheat bran and rice + wheat bran with refined wheat flour and other necessary ingredients. The recipe was standardized and evaluated for physical parameters and overall acceptability. It was observed that cookies prepared with 30 per cent incorporation of fibre was highly acceptable. The use of 30 per cent of fibre in the preparation of cookies is a useful strategy to optimize the consumption of food rich in functional ingredients.

Key Words : Fibre, Rice bran, Wheat bran, Sensory quality

How to cite this article : Suma, K. and Nandini, P.V. (2015). Physical and sensory attributes of fibre enriched cookies. *Food Sci. Res. J.,* **6**(2): 207-214.

INTRODUCTION

Dietary fibre as a class of compound includes a mixture of plant carbohydrate polymers and polysaccharides, eg: cellulose, hemicellulose, pectin substance, gums, resistant starch, inulin, that may be associated with lignin and other non- carbohydrate compounds (eg: polyphenols, waxes, saponins, citrin, phytates, resistant protein) (Elleucha *et al*., 2011). Dietary fibre is an important part of a healthy diet. It helps to move food and waste efficiently through the digestive system (James *et al*., 2010).

Dietary fibre is essentially intact with in the plant matrix and the enzymes with in the human digestive tract are unable to hydrolyze or breakdown. Dietary fibre is made up of three varying compounds. The largest component consists of polysaccharides or plant fibres such as bran; pectins from fruits and vegetables; various gums; and beta glucans from oats and rye (ADA, 2008).

The second largest component is lignin, composed of polyphenol propane molecules and present in very small amounts in the diet. Lignin is found in stalks and stems. The third component is made up of resistant starches and non-digestible oligosaccharides (James *et al*., 2010). These are naturally occurring parts of fibres that resist digestion in the upper digestive tract yet food and stimulate the growth of friendly bacteria in the lower digestive tract. Resistant starches and oligosaccharides are sometimes added to food as isolated ingredients and occur naturally in legumes, various fruits and vegetables, seeds and grains (ADA, 2008)

Fibres add bulk to the diet and fillup, making less likely to snacks on fatty foods. Therefore, we need to eat fibres everyday as part of a balanced diet (Youssef, 2007).

Fibres are generally complex carbohydrates that are mostly found in outer layer of plants. Although it is already in a part of human diet, it has been recently considered as a dietary constituent (Nelson, 2001). It was firstly described as a plant cell wall in 1953 and later on

MEMBERS OF RESEARCH FORUM

Author for correspondence :
K. SUMA, Department of Home Science, College of Agriculture, Vellayani THIRUVANANTHAPURAM (KERALA) INDIA

Associate Authors' :
P.V. NANDINI, Department of Home Science, College of Agriculture, Vellayani, THIRUVANANTHAPURAM (KERALA) INDIA

in 1973 the definition was expanded "indigestible polysaccharides and lignin" terms (Vander *et al.*, 2004). Recently, the AACC updated its definition as following: "Dietary fibre is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine" complete or partial fermentation in the large intestine.

Fibres are available in different kinds of plant sources that can be classified as fruits, cereals, plants generally, since the water content of fruits is higher than cereals, they consist less dietary fibre.

Fibre is mostly complex carbohydrate. The two types of fibre are soluble and insoluble and both are needed for bowel function. Most fibre sources contain both kinds of fibre in varying amounts. Insoluble fibre cannot be dissolved in water. They produce the tough, chewy texture of wheat bran, whole grains, corn bran, and some vegetables. Soluble fibre, or fibre that can dissolve in water, slows the movement of food through the body but does not increase fecal bulk. Soluble fibre helps to maintain a healthy cholesterol level, normalize blood sugar levels in diabetics and may even help to reduce B.P. Pectins and gums are examples of soluble fibres and are found in oats, psyllium husks, apple, beans, moringa leaves and in some fruits and vegetables (ADA, 2008).

In recent years there has been a reawakening of interest in the role of dietary fibres in human nutrition and thus tremendous importance is now being placed upon various cereal brans, legume husks and other potential source of dietary fibre in the formulation of food products, a low intake of which has been linked with such diseases as diverticular disease, cancer of the colon and rectum, appendicitis, varicose veins and hemorrhoids, CHD, gallstone and diabetes mellitus (Bose and Shams, 2010).

Amongst different sources of fibres, cereal bran is the most important and cheap sources of fibre. The outer bran layers of cereal grains are rich in dietary fibre and certain high level of minerals. Wheat bran is about 14.5 per cent of the kernel weight. It is rich in protein (~14.5%), carbohydrate (~27%), minerals (~5%), fat (~6%) and B vitamins (Kent and Evers, 1994). Rice bran is rich in nutrients with 14-16 per cent protein, 12-23 per cent fat and 8-10 per cent crude fibre. It is also a good source of B vitamins and contains minerals such as iron, potassium, calcium, chlorine, magnesium and manganese (Saunders, 1985).

Rice bran is an excellent source of dietary fibre ranging from 20-51 per cent (Saunders,1990). Possible health benefits of consumption include increased fecal bulk and reduced blood cholesterol (Abdul and Yu, 2000). The rice bran/ wheat bran supplementation to wheat flour enhances the content of protein, lysine and dietary fibre proportionately to the level of substitution.

Bakery products such as biscuits/ cookies have high consumer acceptance and are important for delivering bioactive compounds into the human diet (Alpaslan and Hayta, 2006).

Nutritional and functional properties of rice/ wheat bran are well suited foe baked products like cookies, muffins, crackers and biscuits (Barber *et al.*, 1981). "Cookies" is chemically leavened products, also known as "biscuit". Cookies are ideal for nutrient availability, palatability, compactness and convenience. They differ from other baked products like bread and cakes because of having low moisture content, comparatively free from microbial spoilage and long shelf life of the product (Akubor and Ukwuru, 2003).

Cookies are important food product used as snacks by children and adults. These are most commonly relished by school going children, who need more protein. Cookies hold an important position in snack food due to variety in taste, crispness and digestibility.

The growing consumer demands for food with high dietary fibre having good nutritional and sensory quality as well as functional claim has called for research to develop new products, include not only the fibre, nutritional and functional characterization but also considered consumer acceptance.

Keeping in view of the nutritional significance of dietary fibre, cookies were prepared from wheat flour supplemented with rice bran and wheat bran. The objectives of the study were.

– To prepare fibre enriched cookies supplemented with rice bran and wheat bran at different proportion and to assess their sensory qualities.

– To determine the physical properties of the formulated cookies.

METHODOLOGY

The study was carried out in the laboratory of Department of Home Science, College of Agriculture, Vellayani, Trivandrum. The methodology adopted has

been described below.

Procurement of raw material :

Good quality wheat bran and rice bran was procured from Elite Industries, Thrissur and other major ingredients such as wheat flour, sugar, baking powder and other adjuncts were purchased from local supermarket of Trivandrum.

Preparation of flour :

Flour was prepared by substituting the refined flour with wheat bran/ rice bran/ rice bran + wheat bran in the ratio of 50:50, 60:40, 70:30, 80:20, 90:10. Cookies made by 100 per cent refined flour was used as control. Treatment used for the formulation of fibre enriched cookies is given in Table A.

Table A : Treatments used for the preparation of fibre enriched cookies

Treatments	Proportion
$T_{1(control)}$	100% Refined flour (control)
Rice bran	
$T_{2\ (50:50)}$	50% Refined flour + 50% Rice bran
$T_{3\ (60:40)}$	60% Refined flour + 40% Rice bran
$T_{4\ (70:30)}$	70% Refined flour + 30% Rice bran
$T_{5\ (80:20)}$	80% Refined flour + 20% Rice bran
$T_{6\ (90:10)}$	90% Refined flour + 10% Rice bran
Wheat bran	
$T_{7\ (50:50)}$	50% Refined flour + 50% Wheat bran
$T_{8\ (60:40)}$	60% Refined flour + 40% Wheat bran
$T_{9\ (70:30)}$	70% Refined flour + 30% Wheat bran
$T_{10\ (80:20)}$	80% Refined flour + 20% Wheat bran
$T_{11\ (90:10)}$	90% Refined flour + 10% Wheat bran
Rice bran + Wheat bran	
$T_{12\ (50:50)}$	50% Refined flour + 25% Rice bran + 25% Wheat bran
$T_{13\ (60:40)}$	60% Refined flour+20% Rice bran + 20% Wheat bran
$T_{14\ (70:30)}$	70% Refined flour+15% Rice bran + 15% Wheat bran
$T_{15\ (80:20)}$	80% Refined flour + 10% Rice bran +10% Wheat bran

Cookies preparation:

The cookies were prepared after the flour preparation following a standard formulation (control) with the addition of 5 different levels of wheat bran, rice bran and wheat bran + rice bran combination. Table B shows the ingredients used in the preparation of cookies.

Table B : Ingredients used (control)

Ingredients	Quantity
Refined flour	100g
Sugar	50g
Butter	50g
Baking powder	1 teaspoon
Vanilla essence	2-3 drops
Cashew nuts	10g

The method of preparation of cookies is summarized in flow chart (Fig. A).

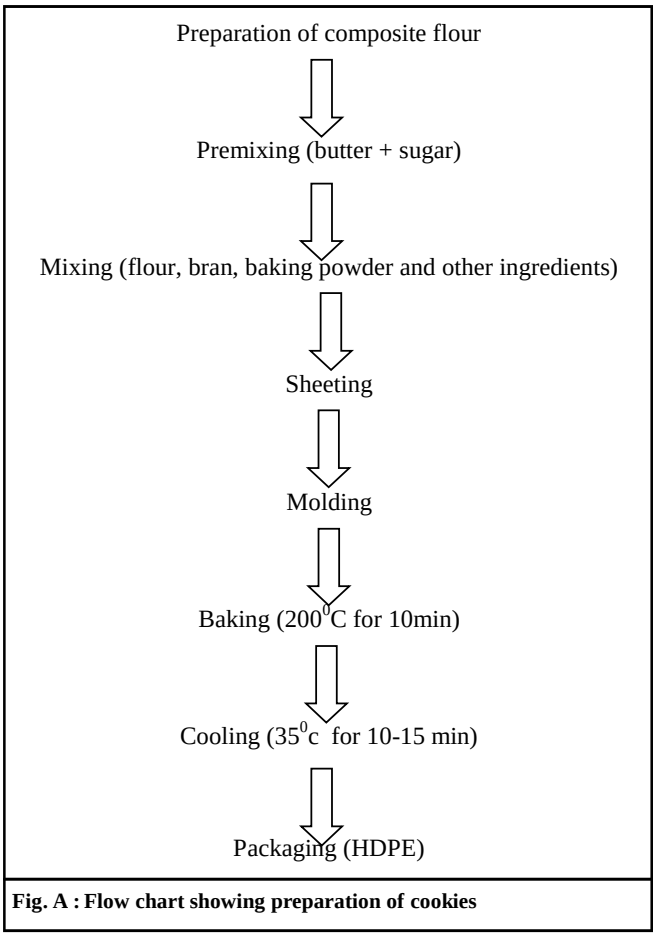

Fig. A : Flow chart showing preparation of cookies

Physical properties :

Fibre enriched (wheat and rice bran) cookies were analyzed for weight, height, diameter, thickness, width and volume and spread ratio according to method given in AACC (2000).

Weight :

Weight of cookies was measured as average of values of six individual cookies with the help of digital weighing balance.

Diameter :

The diameter of cookies were measured by placing

six cookies edge to edge. The total diameter of six cookies was measured.

Thickness :

To determine the thickness, six cookies were placed one above another. The total height of six cookies was measured in millimeter with help of ruler. This was repeated twice to get an average value.

Width :

Six cookies were placed horizontally (edge to edge) and rotated at 90^0 angle for reading.

Volume :

Volume of cookies was measured using the formula.

$V\ (cm^2) = d^2\pi t/4$

t= average thickness

d= diameter

Spread ratio :

The spread ratio was determined by the formula

$$\text{Spread ratio} = \frac{\text{Diameter}}{\text{Thickness}}$$

Sensory evaluation of cookies :

The sensory evaluation of the developed cookies were carried out by an untrained panel of 10 members comprising both students and staffs in the department of Home science using the method of Iwe (2007). The cookies were evaluated by panelist for taste, appearance, texture, flavour, crispness and overall acceptability. The samples were evaluated on a 5 point scale using a score card and also by hedonic scale ranging from 9 (extremely like) to 1 (extremely dislike) and 5 neither like or dislike.

Statistical analysis :

The data was statistically analyzed by performing Analysis of Variance technique (ANOVA) and interpreted according to Duncan's Multiple Range test at 5 per cent level of probability.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Standardization and selection of best combination of formulated cookies :

Standardization and product development play a key role in the growth of food industries. According to Poduval (2002) one of the most important purposes of standardization is to facilitate the movement of materials and products through all stages of production, is any industrial activity starting from the raw material to the finished product, then to the dealers and finally to the retailers and customers.

Fibre enriched cookies were standardized as detailed inmaterials and methods. The selected 14 treatments were subjected to sensory evaluation by hedonic rating to select the best treatments.

Hedonic rating is used to measure the degree of pleasurable and un pleasurable experience of the food product on a scale of 9 point from" like extremely" to "dislike extremely" (Kalia and Sood, 2000).

The results of Table 1 revealed that three combinations of sweet cookies were selected based on their per cent score obtained above 80 which are marked in bold alphabets. The numbers in the parenthesis indicate the number of judges whereas numbers outside parenthesis are the total scores given by judges.

The highest per cent score among sweet cookies was achieved by wheat bran supplemented cookies (70:30) (T_9).

Cookies supplemented with different levels of substitution of cereal bran (rice and wheat) were evaluated and compared with control cookies *i.e.*, cookies made with 100 per cent refined flour. Data indicated that the per cent score of cookies supplemented with 30 per cent bran was found to be acceptable. At 30 per cent level of incorporation, all the sensory attributes scored highest level. Among the 15 treatments three treatments got highest score (T_4, T_9 and T_{14}) and they are selected for the in depth studies.

Sensory evaluation :

Sensory evaluation is a scientific discipline that applies principle of experimental design and statistical analysis to the use of human senses *viz*., sight, smell, taste, touch and hearing for the purposes of evaluating consumer products (IFT, 2005). The sensory parameters such as appearance, flavour, texture taste and overall acceptability of any food products depends on the extent of oxidation of fats and oils in the food due to the

formation of peroxide, aldehydes and ketones (Gupta, 2005).

Appearance :

Appearance is a very important parameter in judging the property of baked cookies that not only reflects the suitable raw material used for the preparation but also provides information about the formulation and quality of product.

Mean quality score of the appearance of cookies is given in Table 2. It was evident from the results that highest score was obtained by cookies prepared from refined flour supplemented with wheat bran (4.50) and while lowest by cookies prepared from 100 per cent refined flour (3.0) (control). Judges have disliked the cookies prepared from refined flour and rice bran (60:40) and (80:20) with respect to appearance when subjected under sensory evaluation. More darkness in the colour of the cookies was observed as the level of supplementation of the brown was increased in the flour.

Crispiness :

Table 2 shows the quality score for the crispiness of the cookies. It was observed from the results that quality score for the crispiness of the cookies ranged from 3.1 to 4.9. The highest value (4.9) was observed in cookies (refined flour + rice bran + wheat bran) prepared in the ratio of 70:15:15 while the lowest score (3.1) was noticed in cookies prepared with refined flour only. Judges have disliked control sample cookies when subjected under sensory evaluation for their crispiness.

Deterioration during storage can manifested itself by changes in physical and chemical characteristics, referred to as spoilage mechanism. In case of physical changes, loss of crispiness occurs due to moisture uptake as biscuits are hydroscopic in nature (Manley, 2002).

Incorporation of protein rich flour which need more water to obtain good cookie dough, and the cookies prepared from high-absorption dough tend to be extremely hard (Hoojjat and Zabik, 1984).

Flavour :

Flavour is the main criterion that a product to be liked or disliked. Mean score for the flavor of the cookies revealed that it was varied among different treatments. The results indicated that the cookies prepared from (refined flour (70%) + wheat bran (15%) + rice bran (15%) got highest score (4.4) for flavor. The judges were also accepted cookies (4.1) prepared with refined flour + rice bran in the ratio of 70:30.

Mouth feel :

Mouth feel of the cookies depends mainly up on the rate of development of the dough and the proportion

Table 1 : Hedonic rating of the formulated cookies

Rating scale	Score	Scores of the sweet cookies														
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}
Like extremely	9	9 (1)			36 (4)					27 (3)		9 (1)		9 (1)	18 (2)	
Like very much	8	32 (4)		8 (1)		24 (3)	24 (3)	16 (2)	32 (4)	40 (5)	16 (2)	8 (1)	16 (2)		48 (6)	40 (5)
Like moderately	7	7 (1)	28 (4)	14 (2)	21 (3)	21 (3)		35 (5)	14 (2)	7 (1)	35 (5)	28 (4)	14 (2)	42 (5)		7 (1)
Like slightly	6	12 (2)	12 (2)	18 (3)	18 (3)	12 (2)	30 (5)	12 (2)	6 (1)	6 (1)	12 (2)	18 (3)	30 (5)		12 (2)	
Neither like or dislike	5	10 (2)		5 (1)		10 (2)	10 (2)	5 (1)	10 (2)		5 (1)			20 (4)		15 (3)
Dislike slightly	4		16 (4)	16 (4)								4 (1)				4 (1)
Dislike moderately	3								3 (1)				3 (1)			
Dislike very much	2															
Dislike extremely	1															
Maximum score	90	70	56	61	75	67	64	68	65	80	68	67	63	71	78	66
Mean preference score		0.77	0.62	0.67	0.83	0.74	0.71	0.75	0.72	0.88	0.75	0.74	0.70	0.78	0.86	0.73
Per cent score		77	62	67	83	74	71	75	72	88	75	74	70	78	86	73

(Figure in Parenthesis denotes the number of judges) ; Number of judges (n) = 10 T_1control-100% Refined flour (control)

T_2 (50:50) 50% Refined flour + 50% Rice bran
T_3 (60:40) 60% Refined flour + 40% Rice bran
T_4 (70:30) 70% Refined flour + 30% Rice bran
T_5 (80:20) 80% Refined flour + 20% Rice bran
T_6 (90:10) 90% Refined flour + 10% Rice bran
T_7 (50:50) 50% Refined flour + 50% Wheat bran
T_8 (60:40) 60% Refined flour + 40% Wheat bran
T_9 (70:30) 70% Refined flour + 30% Wheat bran
T_{10} (80:20)80% Refined flour + 20% Wheat bran
T_{11} (90:10)90% Refined flour + 10% Wheat bran
T_{12} (50:50)50% Refined flour + 25% Rice bran + 25% Wheat bran
T_{13} (60:40)60% Refined flour + 20% Rice bran + 20% Wheat bran
T_{14} (70:30)70% Refined flour + 15% Rice bran + 15% Wheat bran
T_{15} (80:20)80% Refined flour + 10% Rice bran + 10% Wheat bran

of sugar used. Cookies supplemented with 15 per cent wheat bran + 15 per cent rice bran got highest score (4.6) for the quality attribute mouth feel while lowest score (2.5) was obtained for the control sample cookies. The judges were also accepted cookies supplemented with 30 per cent wheat bran (4.2) when subjected under sensory evaluation for their mouth feel.

Taste :

Taste is also influenced by the quality of the raw materials used in the processing of cookies. The highest score for taste was obtained by rice bran + wheat bran supplemented cookies (4.7) in the ratio of 70:30.

Overall acceptability :

It was obvious from the results that supplementation of bran increased the overall acceptability of the cookies. Maximum score (4.56) was obtained by (15% rice bran + 15%wheat bran) incorporated cookies followed by 30 per cent wheat bran (4.28) while minimum score 2.84 and 2.94 were obtained by the cookies, prepared by refined flour (control) and 50 per cent rice bran supplemented cookies, respectively.

Physical properties of the cookies :

Physical properties of cookies are important from both consumer and manufacture point of view. The data on physical analysis is presented in Table 3.

The data revealed that weight of cookies ranged between 13.66g to 16.0g. It was observed that control cookies sample had minimum weight (13.66g). An increase in weight of cookies was observed with the addition of bran. The maximum weight was noticed in cookies supplemented with wheat bran (16.0g). The diameter of cookies was found highest in rice bran + wheat bran supplemented cookies (4.2mm) followed by

Table 2 : Sensory evaluation of formulated cookies

Treatments	Appearance	Crispiness	Flavour	Mouth feel	Taste	Overall acceptability
T_1 control	3	3.1	3.4	2.5	2.2	2.84
Rice bran	3.4	3.3	2.9	2.7	2.4	2.94
$T_{2\ (50:50)}$						
$T_{3\ (60:40)}$	3.2	3.5	3.1	3.1	2.5	3.08
$T_{4\ (70:30)}$	3.7	3.9	3.5	3.9	3.7	3.74
$T_{5\ (80:20)}$	3.2	3.7	3.6	3.6	3.3	3.48
$T_{6\ (90:10)}$	3.6	3.5	3.2	3.2	3.1	3.32
Wheat bran	3.6	3.5	3.6	3.6	3.5	3.56
$T_{7\ (50:50)}$						
$T_{8\ (60:40)}$	4.1	4.1	3.6	3.6	3.6	3.8
$T_{9\ (70:30)}$	4.5	4.2	4.1	4.2	4.4	4.28
$T_{10\ (80:20)}$	4.2	3.7	3.8	4.0	3.8	3.9
$T_{11\ (90:10)}$	3.8	3.6	3.2	3.7	3.2	3.5
Rice bran + Wheat bran	3.4	3.5	3.9	3.2	3.2	3.44
$T_{12\ (50:50)}$						
$T_{13\ (60:40)}$	3.4	4.0	4.1	3.9	3.8	3.84
$T_{14\ (70:30)}$	4.2	4.9	4.4	4.6	4.7	4.56
$T_{15\ (80:20)}$	3.9	4.6	4.1	4.1	4.1	4.16

Table 3 : Physical properties of fibre enriched cookies

Treatments	Weight (g)	Diameter (mm)	Thickness (cm)	Width (mm)	Volume	Spread ratio
Control	13.66^{c}	3.700^{c}	1.137^{b}	4.353^{b}	12.210^{c}	3.254^{a}
Rice bran cookies	15.00^{b}	4.100^{ab}	1.280^{a}	4.547^{a}	16.897^{ab}	3.203^{b}
Wheat bran cookies	16.00^{a}	4.000^{b}	1.270^{a}	4.603^{a}	15.963^{b}	3.149^{b}
Rice bran + wheat bran cookies	15.33^{ab}	4.200^{a}	1.290^{a}	4.593^{a}	17.873^{a}	3.255^{b}
CD Values	0.769	0.188	0.041	0.112	1.851	0.133

Indicates a statistically significant difference (P=0.05)

wheat bran supplemented cookies (4.1mm) (Table 3). Cookies diameter was found to be significantly ($p<0.05$) affected by treatments. The results are in close agreement with Haque *et al.* (2002) who observed that diameter of cookies increased with increase in fibre rice bran cookies on par with cookies supplemented with rice bran (3.90 mm) and rice + wheat bran.

The result of ANOVA on thickness revealed that there was a significant relationship exists between all the bran supplemented cookies. The maximum thickness was noticed in cookies supplemented with rice + wheat bran (1.29cm) followed by wheat bran supplemented cookies (1.28cm). It was observed that cookies which contain more bran exhibited higher thickness than control (1.13cm) (Table 3).

It was interesting to note that spread ratio decreased or remained same in the case of cookies. The results are in close agreement with the findings of Sudha *et al*. (2007). The spread of the cookies should be according to the specification set by the manufacture. Too much elasticity in the gluten and dough will spring back to give thicker cookies due to smaller diameter. Similarly in case of too little elasticity, dough may flow after moulding resulting in thin cookies with large diameter.

Wheat flour was supplemented with 5.25 per cent defatted soy flour which reduced diameter and increased thickness of cookies resulting in a significantly reduced spread ratio (Grover and Singh, 1994).

Spread of cookies decreased with the addition of rice bran (Sekhon *et al.*, 1997). Cookies spread decreased with the addition of the various cereals brans (Sudha *et al.*, 2007). James *et al.* (1989) utilized rice bran soy blends as protein supplementation for cookies and found that the rice bran soy cookies had less spread. Cookies spread occur as sugars dissolve during baking. Surcose is not completely dissolved prior to baking, so the undissolved sugars will dissolve during baking, which allows greater spread to occur in cookies.

Cookies having higher spread ratio are considered most desirable. Also larger cookies diameter and higher spread are considered as the desirable quality attribute

The volume of cookies was found least in control sample cookies (12.21) where as it was found maximum in cookies supplemented with rice and wheat bran (17.87) followed by cookies supplemented with wheat bran (16.89). An increase in volume of cookies was also noticed with the supplementation of bran. The data regarding means for effect of various treatments on width of cookies showed an increasing trend with the addition of bran. The width was found to be highest in wheat bran supplemented cookies (4.60m.m). But according to Nassar *et al*. (2008) a decrease in width of cookies was observed in apple fibre incorporated wheat cookies.

Conclusion :

From the present research work, it was concluded that diameter, volume and thickness was found to be higher in cookies supplemented with rice bran (15%) + wheat bran (15%). The spread ratio was decreased or remained same after the supplementation of bran.

The addition of increasing levels of bran in the cookies affected the quality and sensory attributes. It was found that 30 per cent supplementation of bran (15% rice bran + 15% wheat bran) produced cookies with acceptable quality. It may be concluded from the study that bran can be successfully incorporated in refined flour upto a level of maximum 30 per cent to yield cookies with acceptable sensory attributes.

Bran supplementation significantly improved the dietary fibre, mineral and protein content of the cookies. Hence, development and utilization of cereal bran will not only improve the nutritional status of the population but also helps those suffering from degenerative diseases.

LITERATURE CITED

A.A.C.C. (2000). Approved Method of the AACC. 10th ed., American Association of Cereal Chemists, INC. St., Paul, Minnesota, USA.

Abdul, H.A. and Yu, S.L. (2000). Functional properties of dietary fibre prepared from defatted rice bran. *Food Chem*., **68**(1) : 15-19.

ADA (American Dietetic Association). (2008). Position of the American Dietetic Association: "Health implication of dietary fibre" . *J . Am. Diet Assoc*., **108** (10) : 116-131.

Akubor, P.I. and Ukwuru, M.U. (2003). Functional properties and biscuit making potential of soybean and cassava flour blends**.** *Plant Foods Hum Nutr.*, **58** (3): 1-12.

Alpaslan, M. and Hayta, M. (2006). The effect of flaxseed, soy and corn flours on the textural and sensory properties of a bakery product. *J. Food Quality*., **29** : 617-627.

Barber, S., Benedito, B.C. and Martenz, J. (1981). Rice bran proteins: Potential value of rice bran fractions as protein food ingredients. *Rev. Agroquim. Technol.*, **21** : 247-256.

Boss, D. and Shams-Ud-Din, M. (2010). The effect of Chickpea (Cicer arietinim) husk on the properties of crackers biscuits. *J. Bangladesh. Agri.Univ*., **8**(1):147-152.

Elleucha, M., Bedigian, D., Roiseux, O., Besbes, S., Blecker Ch. and Attia, H. (2011). Dietary fibre and fibre-rich by-products of food processing: Characterization, technological functionality and commercial applications: A Review. *J. Food Chem*., **124**(2):411-421.

Grover, M., and Singh, G. (1994). Evaluation of commercial deffated soy flours for cookies making: Effect on physical and sensory characteristics. *J. Dairying Foods. Home Sci*., **13**(19) : 93-97.

Gupta, K.M. (2005). Bailey's Industrial Oil and Fat Products. John Wiley and Sons Inc., **6**(6): 1-30.

Hoojjat, P. and Zabik, M.E. (1984). Sugar-snap cookies prepared with wheat navy bean-sesame seed flour blends. *Cereal Chemistry*, **61**(1): 41-44.

IFT (2005). The wide scope of sensory evaluation. *Food. Sci. Nutr*., **18**(5): 23-26.

Iwe, M.O. (2007). Current trends in sensory evaluation of foods. Rejoint Comm. Service Ltd. Enugu, Nigeria.

James, C., Courtney, D.L.D. and Lorenz, K. (1989). Rice bran-soy blends as protein supplements in cookies. *Internat. J. Food Sci. Tech*., **24** (5): 495–502.

James, M., Lattimer and Mark, D.H. (2010). Effects of dietary fibre and its components on metabolic health. *Nutrients*, **2**(12): 1266-1289.

Kalia, M. and Sood, S. (2000). *Food preservation and processing*. Kalyani Publishers. 180-189 pp.

Kent, N.L. and Evers, A.D. (1994). *Technology of cereals*. 4th Ed. Pergamon Press Oxford. pp. 276-301.

Manley, D. (2002). *Technology of Biscuit, Crackers and Cookies*. 3rd Ed. Woodhead Pub. Ltd. Cambridge.

Nassar, A.G., Abdel- Hamied, A.A. and El-Naggar, E.A. (2008). Effect of citrus by-products flour incorporation on chemical, rheological and organolepic characteristics of biscuits. *World J. Agri. Sci*., **4**(5):612-616.

Nelson, A.L. (2001). *High-fibre ingredients*: Eagan press handbook series. St Paul, MN: Eagan Press.

Poduval, S. (2002). Diversification and value addition in coconut. In: sustainable production and utilization of coconut. Singh, H.P. and Mthew, M.T (eds) Coconut Development Board, Kochi, 43-44p.

Saunders, R.M. (1985). Rice bran: composition and potential food sources. *Food Rev. Internat.,* **1**(3):465-495.

Saunders, R.M. (1990). The properties of rice bran as a foodstuff. *Cereal Foods World*., **35**(7): 632-636.

Sekhon, K.S., Dhillon, S.S., Singh, N. and Singh, B. (1997). Functional suitability of commercially milled rice bran in India for use in different food products. *Plant Foods Hum. Nutr.,* **50**(2): 127-140.

Sudha, M.L., Baskaran, V. and Leelavathi, K. (2007). Influence of fibre from different cereals on the rheological characteristics of wheat flour dough and on biscuit quality. *Food Chem*., **100**(4): 686-692.

Van Der, K.J.W., Asp, N.G. and Miller-Jones J.S.G. (Eds.). (2004). Dietary fibre; bio-active carbohydrates for food and feed. Portland: Book News.

Youssef, M.K.E. (2007). Food that fight cancer. Proceedings of the six th conferences of woman and scientific research and development in upper Egypt. **17**(19): 213-228.

Received : *13.05.2015;* **Revised:** *05.08.2015;* **Accepted :** *15.08.2015*