

## DEVELOPMENT, PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF BISCUITS SUPPLEMENTED WITH PUMPKIN SEEDS TO COMBAT CHILDHOOD MALNUTRITION IN PAKISTAN

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**ABSTRACT:-** This study was carried out in Food Science and Product Development Institute, National Agricultural Research Centre, Islamabad, Pakistan in 2014. Nutritive pumpkin seed flour fortified biscuits were prepared with four different substituted levels of pumpkin seed flour in wheat flour ( $T_2=5\%$ ,  $T_3=10\%$ ,  $T_4=15\%$  and  $T_5=20\%$ ), were compared with control ( $T_1$ ). Chemical attributes of biscuits showed that  $T_5$  has maximum level of pumpkin flour (20%) with maximum protein (12.30%), fat (28.29%), ash (4.13%), iron (2.28%) and zinc (3.11%). Sensory results also revealed increasing trend in all sensory parameters. Results showed acceptability at all levels but treatment  $T_4$  with 15 % pumpkin seed flour scored highest (8.0) for maximum overall acceptability. It was concluded that pumpkin seed flour can be supplemented successfully to partially replace wheat flour to prepare highly nutritious biscuits without affecting its overall acceptability.

*Key Words: Biscuit; Pumpkin Seeds; Chemical Analysis; Sensory Evaluation; Pakistan.*

### INTRODUCTION

A healthy person depends on healthy food system. Malnutrition today imposes high cost on society, and comes in many different forms. One out of five children in the world under the age of five is stunted and around 165 million children in the world are malnourished (FAO, 2013). Moreover, about 2 billion people in the world lack vitamins and minerals which are essential for healthy life (FAO/WHO, 2004). Half of the humanity is affected by the deficiency of trace elements (WHO/EMRO, 2009). Considerable attention has been generated to fortify wheat flour products with high protein, oil seed flours and isolates for this used in baked products considered best due

to worldwide consumption (Hoover, 1979).

In under developed countries malnutrition is affecting around 800 people. Protein malnutrition is prominent in all nutrient deficiencies. World Health Organization (WHO) called the protein energy malnutrition as silent emergency (Anonymous, 2003). To overcome this disastrous malnutrition Bill gate foundations (2007-2009) sponsored research funds and introduced legumes that not only provide proteins but also improved nutritional status of the seeds (Anuonye, 2011).

Iron deficiency adversely affects the physical growth of infants, pre-schoolers and school-aged children. It affects badly cognitive and work performance both including immune

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status of adolescents and adults of all age groups (WHO, 2001). Developing countries are suffering from micro-nutrient malnutrition in which iron is most prevalent micronutrient (Kennedy and Meyers, 2005).

According to Prasad (2003), zinc is an important nutrient for human health and essential for life: plays vital role for the health of hair, bones, nails, muscles, teeth as well as nerves, brain and growth. Its deficiency causes loss of appetite, taste failure and cognitive disability. It also plays an important role in immune function, sex maturation, energy metabolism, sensation of taste and smell. It is required for metabolic activities of enzymes, which are important for synthesis of fat, protein, carbohydrate and alcohol; it also helps in cell division and synthesis of DNA. In males, it is responsible for sperm production and maintains the normal function of prostate. Deficient amount of zinc in pregnant female will lead to retarded growth and mental health of fetus (Bhowmic et al., 2010).

Pumpkin belongs to Cucurbitaceae. Its seeds are good source of fat, protein, carbohydrate and potential source of minerals. In recent years pumpkin seeds received considerable attention due to its nutritional value. Its seeds can be used in snacks and its flour can also be used in making low fat food spread (Ivana et al., 2014). The seeds can also be fortified in bread and different bakery products (Elinge et al., 2012; Mirjana et al., 2014).

Supplementary foods used to reduce the malnutrition. Supplementation should be in ready to eat bakery products and drinks. Biscuit is the combination of two French words bis (twice) cuit (cooked) holds

an important position in snack food due to variety in tastes, crispness, and digestibility (Opawale et al., 2011). Considering, the malnutrition and low energy intake among the children in Pakistan, the current study is designed to develop high energy biscuits supplemented with pumpkin seeds for nutritional improvement and evaluate the chemical and organoleptic attributes of supplemented biscuits.

## MATERIALS AND METHOD

### Sample Collection

The present study was designed to evaluate the suitability of partially replacing maida by using pumpkin seeds in biscuit manufacturing. The whole raw material was purchased from the Islamabad market. Composition of biscuits with patent flour and pumpkin was as follows:

- T<sub>1</sub> = Control; 100% patent flour
- T<sub>2</sub> = 5% pumpkin + 95% patent flour
- T<sub>3</sub> = 10% pumpkin + 90% patent flour
- T<sub>4</sub> = 15% pumpkin + 85% patent flour
- T<sub>5</sub> = 20% pumpkin + 80% patent flour

### Preparation of Biscuits

Biscuits were prepared according to the American Association of Cereal Chemists (AACC, 1983) Method No.10.52 with slight modifications. Simple recipe was adopted by using prepared composite flour of chickpea and oat with different proportions with sugar, eggs and baking powder with shortening. Mixing was done with mixer of Sanyo food factory instead of that mentioned in AACC (1983) method.

**Chemical Analysis**

Moisture, crude protein, crude fat, crude fiber, ash and total dietary fibers were determined according to the standard methods of AACC (2000).

**Sensory Evaluation**

Fresh supplemented biscuits prepared from different level of pumpkin seeds were subjected to sensory evaluation for texture, color, taste, aroma, and flavor and overall acceptability. Evaluation was done by a panel of Judges according to the method described by Larmond. (1977) with instruction score card.

**Statistical Analysis**

Each sample of flour and biscuits was analyzed in triplicate and the values were then averaged. Data was assessed by standad deviation.

**RESULTS AND DISCUSSION**

Five treatments of supplemented biscuits made from maida and pumpkin seeds were evaluated. Incorporated biscuits were analyzed for moisture, ash, protein, fat, crude fiber, Fe and zinc. Chemical analysis of nutritious biscuits revealed that enrichment level of pumpkin seeds in biscuits significantly affected the moisture content of the biscuits (Table 1). Supplementation level decreases the moisture content because the low level of moisture in pumpkin seeds cause decrease in moisture in biscuits which enables them to preserve for long time. Present findings of low level of moisture content are in accordance with those of Nyam et al. (2013) who observed low level of moisture content in pumpkin seeds while ash content of the enriched biscuits increases

with increase of supplementation. High ash content was observed in T<sub>5</sub>. Our findings are in accordance with the findings of Giami et al. (2005) who also observed increase in the ash content with increased level of pumpkin seeds in cookies.

Protein contents increased with increase of substitution of pumpkin seeds. High protein content was observed in T<sub>5</sub> (20% pumpkin + 85% maida) which is desirable because the aim of the study was also to increase the protein content of the diet. The same increasing trend of protein was observed by Atuonwu and Akobundu (2010). With increase of supplementation level in the biscuits the mean values for crude fat contents of nutritious biscuits increase and highest fat contents were found in T<sub>5</sub>. Analysis of crude fiber content of the biscuits significantly increased (P<0.05) with increasing fortification level while the control sample(100 %) had least value of fiber which is due to low fiber content in maida (white flour). However, highest fiber content was recorded in T<sub>5</sub>. Increase in the fiber content of the biscuits is desirable because fiber is good source to control cholesterol level, many digestive problems as well as can decrease risks of cancer. But overall increase in the ash content of the biscuit was low because of low ash content in pumpkin seeds. Albin-Hermetter (2007) also mentioned low ash, fiber and carbohydrate in the pumpkin seeds. Increase in iron and zinc was found with increase in the level of enrichment of pumpkin. As the aim of the study was also the nutritional improvement, the increase in the iron and zinc contents was significant. Highest increase of zinc and iron content was observed in T<sub>5</sub>.

**Table 1. Proximate and mineral composition of pumpkin seed biscuits**

Samples	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Crude fiber (%)	Iron (mg/100g)	Zinc (mg/100g)
T <sub>1</sub> (Control)	4.76 <sup>a</sup> ± 0.06	1.68 <sup>c</sup> ± 0.03	9.20 <sup>e</sup> ± 0.07	20.39 <sup>e</sup> ± 0.04	3.40 <sup>a</sup> ± 0.04	0.364 <sup>e</sup> ± 0.01	0.96 <sup>e</sup> ± 0.03
T <sub>2</sub>	4.30 <sup>b</sup> ± 0.02	2.02 <sup>d</sup> ± 0.00	9.32 <sup>d</sup> ± 0.03	21.78 <sup>d</sup> ± 0.03	3.23 <sup>b</sup> ± 0.04	0.604 <sup>d</sup> ± 0.01	1.45 <sup>d</sup> ± 0.01
T <sub>3</sub>	3.40 <sup>c</sup> ± 0.04	2.9 <sup>c</sup> ± 0.02	10.30 <sup>c</sup> ± 0.03	23.78 <sup>c</sup> ± 0.03	3.06 <sup>c</sup> ± 0.03	0.952 <sup>c</sup> ± 0.07	1.95 <sup>c</sup> ± 0.01
T <sub>4</sub>	2.59 <sup>d</sup> ± 0.04	3.78 <sup>b</sup> ± 0.04	11.24 <sup>b</sup> ± 0.02	26.09 <sup>b</sup> ± 0.02	2.70 <sup>d</sup> ± 0.07	1.260 <sup>b</sup> ± 0.04	2.89 <sup>b</sup> ± 0.04
T <sub>5</sub>	1.55 <sup>a</sup> ± 0.58	4.13 <sup>a</sup> ± 0.44	12.30 <sup>a</sup> ± 0.67	28.29 <sup>c</sup> ± 0.58	1.60 <sup>e</sup> ± 0.08	2.280 <sup>a</sup> ± 0.08	3.11 <sup>a</sup> ± 0.35

Means followed by same letter do not differ significantly.

Similar, increase in iron and zinc was also observed by El-Soukkary (2001).

### Sensory Evaluation

Sensory evaluation of nutritious biscuits for different parameters shows significant differences among different treatment (Table 2). The results of texture indicated that there is significant difference among all treatments of nutritious biscuits. Control got 5.0 score and T<sub>4</sub> and T<sub>5</sub> got 7 and 6.5, respectively. The difference in texture is due to high protein content in the raw material. Atuonwu and Akobundu (2010) also observed improvement in the texture of cookies supplemented with pumpkin seeds. The color score ranges between 5 and 7. The change in color was due to high protein content in the pumpkin seeds which is desirable. Increase in the color score of biscuits is attributed to

sugar caramelization and the maillard reactions between sugars and amino acids and same finding were obtained by Siddiqui et al. (2003) who found increase in the color score with increase in supplementation level. Biscuits were significantly different in flavor. Highest score was obtained in control and T<sub>4</sub> (15% pumpkin + 85% patent flour) and lowest was in control. The increasing trend in the flavor was also observed by Atuonwu and Akobundu (2010) they also noted increase in flavor score with increase in the level of pumpkin seeds. Increase in the score of the aroma of the nutritious biscuits was roasted pumpkin seed (roasting of pumpkin seeds during processing) which is necessary for the development of characteristics aroma in seeds (Siegmond and Murkovic, 2004) and these aromatic seeds lead to good

**Table 2. Sensory evaluation of pumpkin seed biscuits**

Treatment	Color	Flavor	Texture	Aroma	Overall acceptability
T <sub>1</sub> (Control)	6.0 <sup>b</sup> ± 0.58	5.0 <sup>b</sup> ± 0.44	5.0 <sup>b</sup> ± 0.00	6.0 <sup>b</sup> ± 0.58	6.0 <sup>b</sup> ± 0.50
T <sub>2</sub>	5.0 <sup>b</sup> ± 0.44	6.0 <sup>b</sup> ± 1.00	5.5 <sup>b</sup> ± 0.50	6.0 <sup>b</sup> ± 0.00	6.5 <sup>bc</sup> ± 0.50
T <sub>3</sub>	6.0 <sup>b</sup> ± 0.00	6.0 <sup>b</sup> ± 0.00	6.5 <sup>a</sup> ± 0.50	6.5 <sup>b</sup> ± 0.50	7.0 <sup>b</sup> ± 0.50
T <sub>4</sub>	7.0 <sup>b</sup> ± 0.29	7.5 <sup>a</sup> ± 0.50	7.0 <sup>a</sup> ± 0.58	7.5 <sup>a</sup> ± 0.50	8.0 <sup>a</sup> ± 0.29
T <sub>5</sub>	6.8 <sup>b</sup> ± 0.58	6.5 <sup>bc</sup> ± 0.61	6.0 <sup>c</sup> ± 0.53	7.5 <sup>a</sup> ± 0.58	7.0 <sup>b</sup> ± 0.54

Means followed by same letter do not differ significantly.

aroma in biscuits production. Data regarding over all acceptability differ among different treatments significantly. Overall acceptability was totally different quality parameters and it was not affected by individual trend of color texture and flavor. Findings indicated that control got lowest score while treatment T<sub>4</sub> is highly acceptable. Findings of Atuonwu and Akobundu (2010) are matching with our findings of biscuits supplemented with pumpkin seeds.

The sensory evaluation of pumpkin supplemented biscuits was done by 6 members. The results revealed that substitution of wheat flour with pumpkin seeds T<sub>4</sub> (15% pumpkin + 85% patent flour) produced acceptable biscuits. The same results were obtained by Atuonwu and Akobundu (2010).

From the chemical analysis it is revealed that all the treatment were in acceptable range due to increase in the nutrient content but after organoleptic/sensory evaluation it is concluded that treatment T<sub>4</sub> scored highest and is recommended for production.

#### LITERATURE CITED

- AACC. 1983. Official methods of analysis. Association of Official Analytical Chemists. 18<sup>th</sup> edn. Virginia, USA.
- AACC. 2000. Approved Methods of the American Association of Cereal Chemist. Am Assoc. Cereal Chem. Inc. St. Paul, Minnesota, USA.
- Albin-Hermetter, G.F. 2007. Seeds and oil of the styrian oil pumpkin Components and biological activities. Eur. J. Lipid Sci. Technol. 109: 1128-1140.
- Anonymous. 2003. Malnutrition the silent emergency. Watch Tower Bible Tract Society, N. Y. p. 3-11.
- Anuonye, J.C. 2011. Soybean utilization and fortification of indigenous foods in times of climate changes. Intech Open Access Publisher. p. 978-958.
- Atuonwu, A.C. and E.N.T. Akobundu. 2010. Nutritional and sensory quality of cookies supplemented with defatted pumpkin (*Cucurbita pepo*) seed flour. Pakistan J. Nutr. 9(7): 672-677.
- Bhowmic, D., Chiranjib, Pankaj T., K.K. Tripathi and K.P.S. Kumar. 2010. Ann. Biol. Res. 1(1): 41-46.
- Elinge, C.M., A. Muhammad, F.A.I Atiku, A.U. Itodo, I.J. Peni and A.N. Mbongo. 2012. Proximate, mineral and anti-nutrient composition of pumpkin (*Cucurbita pepo* L.) seeds extract. Intern. J. Pl. Res 2(5): 146-150.
- El-Soukkary, F.A.H. 2001. Evaluation of pumpkin seed products for bread fortification. Plant Foods Hum. Nutr. 56: 365-384.
- FAO. 2013. State of food insecurity in the world, 2013. The multiple dimension of food security Rome. FAO. p. 8-29.
- FAO/WHO. 2004. Vitamin and mineral requirement in human nutrition. 2<sup>nd</sup> edn. Bangkok. WHO/ FAO. 341 p.
- Giami, S.Y., S.C. Achinewhu and C. Ibaakee. 2005. The quality and sensory attributes of cookies supplemented with fluted pumpkin (*Telfairia occidentalis* Hook) seed flour. Intern. J. Food. Sci. Technol. 40: 613-620.
- Hoover, W. 1979. Use of soy proteins in baked foods. J. Am. Oil. Chem. Soc. 56:301.
- Ivana, N., L. Dokic, V. Krstonošic, Z. Sereš and D.S. Simovic. 2014. Possibility of the production of functional low-fat food spread of

- hull-less pumpkin seed flour from rheological and textural aspect. *J. Texture Studies*, 45(4): 324-333.
- Kennedy, E. and L. Meyers. 2005. Dietary reference intakes: Development and uses for assessment of micronutrient status of women, a global perspective. *Am. J. Clin. Nutr.* 81(5): 1194-1197.
- Larmond, E. 1997. Laboratory methods for sensory evaluation of food, Research Branch, Department of Agriculture, Ottawa, Canada.
- Mirjana, M.M., A.D. Mirjana, V.V. Biljana, M.Z. Branka and R.I. Stikić. 2014. Evaluation of the nutritional quality of wheat bread prepared with quinoa, buckwheat and pumpkin seed blends. *J. Agric. Sci.* 59(3): 319-328.
- Nyam, K.L., M. Lau and C.P. Tan. 2013. Fiber from pumpkin (*Cucurbita pepo* L.) seeds and rinds physico-chemical properties, antioxidant capacity and application as bakery product ingredients. *Mal Nutr.* 19(1): 99-109.
- Opawale, B.O., O.E. Giwa, O.R. Jose, O.A. Aladejimokun and A.K. Aladenika. 2011. Physical, sensory and microbial attributes of taro flour supplemental cookies. *National Conf. Proc. Interdisciplinary Cooperation. A Panacea for Food Security.* p.1-6.
- Prasad, A.S. 2003. Zinc deficiency has been known of for 40 years but ignored by global health organizations *British Med. J.* 22(326): 409-410.
- Siddiqui, N., M. Hassan, S. Raza and T. Hameed. 2003. Sensory and physical evaluation of biscuits supplemented with soy flour. *Pakistan. J. Food Sci.* 13(1-2): 45-48.
- Siegmund, B. and M. Murakovic. 2004. Changes in chemical composition of pumpkin seeds during the roasting process for production of pumpkin seeds oil. *Volatile compounds Food Chem.* 84(2): 367-374.
- WHO. 2001. Iron Deficiency Anemia Assessment, Prevention and Control. A guide for programme managers.
- WHO/EMRO. 2009. Regional data on no communicable diseases risk factors, WHO Regional Office of East Mediterranean. Non communicable website (<http://www.emro.who.int.ned>)

#### AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No.	Author Name	Contribution to the paper
1.	Ms. Saima Kanwal	Abstract, Methodology
2.	Dr. Saeeda Raza	Conceived the idea, Technical input at every step
3.	Mr. Khalid Naseem	Overall management of the article
4.	Mr. Muhammad Amjad	Results and discussion
5.	Mr. Naseem Bibi	References
6.	Ms. Musarrat Gillani	Data collection

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