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Vandana
Ph.D. Scholar, Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, US Nagar, Uttarakhand, India

Sarita Srivastava
Professor and Head, Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, US Nagar, Uttarakhand, India

Corresponding Author:
Vandana
Ph.D. Scholar, Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, US Nagar, Uttarakhand, India

Study on shelf life of QPM incorporated noodles

Vandana and Sarita Srivastava

Abstract
In the present study shelf life of QPM incorporated noodles was studied in terms of moisture content, peroxide value, free fatty acid, microbiological qualities and sensory properties for a period of three months at ambient temperature in two types of packaging material viz. LDPE and aluminium laminated packets. The noodles were formulated by incorporating QPM flour and refined wheat flour at the ratio of 44:44, 12 g gluten, 0.2 g guar gum and 53 ml water used for dough making. Control noodles were prepared from only refined wheat flour. These noodles were dried in hot air oven at 39^{0}C for 6-8 hours. There was seen non-significant increase in moisture content, peroxide value, free fatty acids and microbiological parameters upto three months of storage. The noodles were found to be suitable for consumption upto 90 days of storage at room temperatures in both type of packaging material.

Keywords: QPM, noodles, LDPE, aluminium laminated packets, shelf life

Introduction
Quality Protein Maize (QPM) has recently fetched abundant attention in international market as it contains twice the amount of lysine and tryptophan as compared to normal maize (Ruiz *et al*., 2008) [1]. QPM is a derivative of opaque-2 maize. It was developed at the International Maize and Wheat Improvement Centre, CIMMYT in Mexico. It can be processed into food products with improved protein quality.
Noodles are widely consumed throughout the world because these are economical, tasty, easy to prepare, shelf stable. These can also be served in different ways. Global consumption of noodles is second after the bread (Pakhare *et al*., 2016) [2]. Because of the high popularity, these could also be used as a vehicle to improve the nutritive value of the habitual diets (Kumar *et al.*, 2019) [3]. Flour of hard wheat (*Triticum aestivum* L.) is the primary ingredient used to make noodles which is not only low in fiber and protein contents but also low in essential amino acid such as lysine. Traditional noodles lack essential nutritional components such as vitamins, minerals, dietary fibre and bioactive compounds. Now a days consumer demand food products which are supplemented with vitamins, minerals and free from synthetic additives. So, one of the greatest challenges in today's world is to develop food products that are inexpensive, nutritionally superior and also highly acceptable that fulfill the need of the consumers.
The consumer preferences have increased for high food quality and accordingly they expect that the food quality will be intact at a high level throughout the period between purchase and consumption. Shelf life is an important feature of all foods, including raw materials, ingredients and manufactured products. "Shelf life is defined as the time during which the food products will remain safe; be certain to retain desired sensory, chemical, physical and microbiological characteristics; comply with any label declaration of nutritional data and be acceptable to the consumer (Earle and Earle, 2008) [4]. So, shelf life study helps to determine the keeping quality of the product. Factors which determine the shelf life of food product are processing, method of preservation, packaging and microbial count (Pakhare *et al*., 2016) [2]. Packaging plays an important role in preserving the functional and sensory qualities of food. It also helps in providing correct environmental conditions for food and protects it against microbiological, physical or chemical degradation (Komolafe, 2005) [5].
Hence the present investigation was carried out to know the best packaging material which extends the shelf life of QPM noodles while retaining all its properties.

Materials and Methods
Place of study
Present study was carried out in the Department of Foods and Nutrition, College of Home Science, GBPUA&T, Pantnagar, Uttarakhand, India.

Procurement of the samples
Vivek QPM-9 was procured from Vivekananda Parvatiya Krishi Anusandhan Sansthan VPKAS, Almora, Uttarakhand. Gluten and guar gum were purchased from Honey Confectionary, Rudrapur, Uttarakhand while refined wheat flour was purchased from the local market of Pantnagar, Uttarakhand.

Method for preparation of flour
QPM grains were cleaned manually to remove dust, stones and other impurities. According to Shobha *et al.* (2011) [6] nixtamalization process of QPM grains was carried out. Five hundred gram of whole grains were soaked in 1% calcium hydroxide solution and then cooked for 30 min at 85^{0}C. The nixtamal was steeped over night at 32±1^{0}C, followed with washing in excess tap water. The grains were spread on tray and dried in a dryer at 60^{0}C until the moisture percentage reached to 9-10% with constant mixing. After drying the grains were milled in the milling machine and passed through 60 mesh sieve. The prepared flour was stored in airtight containers for further preparation.

Preparation of noodles
Response surface methodology (RSM) was used to optimize the level of QPM: refined wheat flour (RWF), gluten and water used for dough making in the preparation of noodles. Noodles were prepared following the procedure of Dixit and Chaudhary (2017) [7]. The optimized QPM noodles contained 44.0g QPM flour, 44.0g RWF, 12 g gluten, 0.2 g guar gum and 53 ml water used for dough making. The control noodles were prepared from 100 percent refined wheat flour. Dough was prepared by continuously kneading with the help of hand for 15 minutes, followed by resting for 20 minutes at room temperature. Noodles were than extruded by using hand operated pasta machine. These noodles were dried in hot air oven at 39^{0}C for 6-8 hours to attain moisture content less than 12 percent as per the PFA specifications for noodles.

Storage studies
Optimized QPM noodles were stored along with control samples for three months at ambient conditions (temperature ranged from 28-32^{0}C and relative humidity 70-80 percent) in two types of packaging material viz. aluminum laminated packets and low-density polyethylene (LDPE) of 150 gauge of thickness. The samples were drawn at 0, 30th, 60th and 90th days of storage for conducting storage study.
Moisture content and free fatty acid content in optimized QPM noodles and refined wheat flour noodles were analyzed as per AOAC (1995) [8], peroxide value was estimated as per American Oil Chemists Society (AOCS,1997) [9] and microbiological quality was determined using standard plate count (SPC) technique as given in the compendium of methods for microbiological examination of foods (APHA,1984) [10].

Sensory quality
Refined wheat flour noodles and optimized QPM noodles were evaluated for sensory characteristics using score card method by 10 semi-trained panel members from the Department of Foods and Nutrition, College of Home Science, GBPUA&T, Pantnagar. Water was provided to rinse the mouth between the samples and noodles were served in paper plate with fork for comfortable testing.

Noodles cooking for assessing sensory quality
Noodles (100g) were cooked in 350 ml of boiling water with occasional stirring till white core disappear.

Statistical analysis
Statistical analysis was carried out using analysis of variance (ANOVA) by taking mean of 10 semi-trained judges for various sensory parameters. Data obtained from each treatment was subjected to one-way analysis of variance (ANOVA) to test the storage parameters in order to measure significant differences.

Results and Discussion
Moisture content
Moisture content greatly affects the physical and chemical properties of food which are related to freshness and stability during storage (Isengard, 2001) [11]. Table 1 represents that packaging material has a non-significant effect on the moisture content of the formulated noodles. The initial moisture content of optimized QPM noodles and refined wheat flour noodles was 7.90 and 7.67 percent, respectively. On 90 days of storage the moisture content of optimized QPM noodles in LDPE was 8.37 percent and in aluminum laminated packets was 8.24 percent, respectively while the moisture content of RWF noodles in LDPE was 7.90 percent and in aluminum laminated packets was 7.85 percent, respectively. Kaur *et al.* (2017) [12] also reported that moisture content of pasta prepared from wheat flour stored in high density polyethylene (temperature 20-30^{0}C, RH 55-75%) did not show significant changes during storage for 90 days.

Table 1: Moisture content (percent) of optimized QPM noodles and control refined flour noodles during storage

Storage period	Optimized QPM noodles #		RWF noodles	
	LDPE	Aluminum laminated packets	LDPE	Aluminum laminated packets
0	7.90±0.66	7.90±0.66	7.67±0.06	7.67±0.06
30	8.13±0.61	8.10±0.53	7.72±0.10	7.70±0.62
60	8.20±0.62	8.13±0.65	7.79±0.27	7.77±0.54
90	8.37±0.35	8.24±0.35	7.90±0.3	7.85±0.58
S.Em.	0.29	0.37	0.10	0.33
C. D. @ 5%	NS	NS	NS	NS

All results are mean ± standard deviation of three values LDPE= Low Density Polyethylene
#QPM: RWF+ gluten+ water used for dough making + guar gum-44:44 + 12 g +53 ml + 0.2 g
S/NS signifies significant and non-significant difference, respectively. S.Em. - standard error of mean, C.D.- critical difference

Peroxide value
Peroxide value is used as an indicator of fat deterioration which takes place due to oxidation of fat. Table 2 revealed that the initial peroxide value of the optimized QPM noodles

was 0.31 m eq/kg fat while the final peroxide value was 0.54 and 0.50 m eq/kg fat, respectively for LDPE and aluminum laminated packets after 90 days of storage. For refined wheat flour noodles, the peroxide values at 0 day was 0.12 m eq/kg fat and after 90 days of storage, the final peroxide value was 0.28 and 0.24 m eq/kg fat, respectively for LDPE and aluminum laminated packets. There has been found non-significant increase in peroxide value in both optimized QPM noodles and refined wheat flour noodles irrespective of packaging materials. Shobha *et al.* (2015) [13] also reported non-significant increase in peroxide value of normal noodles (0.63-0.64 m eq/kg fat) and QPM noodles (0.61-0.63 m eq/kg fat) upto three months of storage.

Table 2: Peroxide value (m eq/kg fat) of optimized QPM noodles and control refined wheat flour noodles during storage

Storage period	Optimized QPM noodles #		RWF noodles	
	LDPE	Aluminum laminated packets	LDPE	Aluminum laminated packets
0	0.31±0.11	0.31±0.11	0.12±0.07	0.12±0.07
30	0.40±0.13	0.38±0.15	0.17±0.07	0.14±0.06
60	0.49±0.12	0.45±0.12	0.22±0.09	0.18±0.08
90	0.54±0.19	0.50±0.09	0.28±0.11	0.24±0.09
S.Em.	0.08	0.07	0.06	0.05
C. D. @ 5%	NS	NS	NS	NS

All results are mean ± standard deviation of three values LDPE= Low Density Polyethylene
#QPM: RWF+ gluten+ water used for dough making + guar gum-44:44 + 12 g +53 ml + 0.2 g
S/NS signifies significant and non-significant difference, respectively. S.Em. - standard error of mean, C.D.- critical difference

Free fatty acid (FFA)

Table 3 reveals that there was a non-significant increase in the FFA with storage days. FFA value at 0 day was 0.44 (% oleic acid) for optimized QPM noodles and the final FFA value after 90 days of storage, was 0.64 and 0.60 (% oleic acid), respectively for LDPE and aluminum laminated packets. While in case of RWF noodles, initially FFA was 0.23 (% oleic acid) and after 90 days of storage, the final FFA value was 0.45 and 0.40 (% oleic acid), respectively for LDPE and aluminum laminated packets.

Table 3: Free fatty acid (% oleic acid) of optimized QPM noodles and control refined wheat flour noodles during storage

Storage period	Optimized QPM noodles#		RWF noodles	
	LDPE	Aluminum laminated packets	LDPE	Aluminum laminated packets
0	0.44±0.13	0.44±0.13	0.23±0.12	0.23±0.12
30	0.50±0.14	0.47±0.11	0.30±0.10	0.29±0.08
60	0.59±0.09	0.55±0.09	0.38±0.13	0.35±0.11
90	0.64±0.08	0.60±0.10	0.45±0.10	0.40±0.10
S.Em.	0.07	0.07	0.08	0.06
C. D. @ 5%	NS	NS	NS	NS

All results are mean ± standard deviation of three values LDPE= Low Density Polyethylene
#QPM: RWF+ gluten+ water used for dough making + guar gum-44:44 + 12 g +53 ml + 0.2 g
S/NS signifies significant and non-significant difference, respectively. S.Em.- standard error of mean, C.D.- critical difference

Sensory quality

Table 4 show non-significant decrease in all the sensory parameters viz. color, flavor, texture, taste and overall acceptability of optimized QPM noodles and control refined wheat flour noodles upto 90 days. The optimized QPM noodles at 0 day had color, flavor, texture, taste and overall acceptability of 7.70, 7.80, 7.90, 7.90 and 7.90 percent, respectively. On 90 day the color, flavor, texture, taste and overall acceptability of optimized QPM noodles in LDPE was reported to be 7.10, 7.10, 7.2,7.0 and 7.0 percent, respectively while in aluminum laminated packets was 7.20, 7.30, 7.30, 7.30 and 7.10 percent, respectively. The RWF noodles at 0 day showed color, flavor, texture, taste and overall acceptability of 7.9, 8.0, 7.90, 7.70 and 7.60 percent, respectively while the color, flavor, texture, taste and overall acceptability in LDPE was 7.20, 7.30, 7.20, 7.10 and 7.0 percent, respectively while in aluminum laminated packets was 7.40, 7.30, 7.40, 7.40 and 7.40 percent, respectively after 90 days of storage.

Table 4: Sensory quality of optimized QPM noodles and control refined wheat flour noodles during storage

Storage period	Optimized QPM noodles#		RWF noodles	
	LDPE	Aluminum laminated packets	LDPE	Aluminum laminated packets
Colour				
0	7.7±0.67	7.7±0.67	7.9±0.94	7.9±0.94
30	7.4±1.51	7.4±0.84	7.6±1.17	7.8±0.79
60	7.2±1.42	7.4±0.8	7.4±0.84	7.7±0.48
90	7.1±0.88	7.2±0.42	7.2±1.14	7.4±0.52
S.Em.	0.20	0.19	0.30	0.20
C. D. @ 5%	NS	NS	NS	NS
Flavour				

0	7.8±0.79	7.8±0.79	8.0±0.67	8.0±0.67
30	7.6±1.25	7.7±0.48	7.8±1.40	7.9±0.57
60	7.3±0.67	7.6±0.52	7.5±0.53	7.8±1.03
90	7.1±0.99	7.3±0.48	7.3±0.32	7.3±0.48
S.Em.	0.30	0.2	0.26	0.2
C. D. @ 5%	NS	NS	NS	NS
Texture				
0	7.9±1.10	7.9±1.10	7.9±0.74	7.9±0.74
30	7.3±0.48	7.5±0.53	7.7±0.48	7.9±0.48
60	7.1±0.74	7.4±0.70	7.5±0.53	7.7±0.85
90	7.2±0.82	7.3±0.48	7.2±0.48	7.4±0.52
S.Em.	0.3	0.23	0.20	0.20
C. D. @ 5%	NS	NS	NS	NS
Taste				
0	7.9±0.74	7.9±0.74	7.7±0.67	7.7±0.67
30	7.4±1.51	7.7±0.67	7.6±0.52	7.7±0.48
60	7.2±1.32	7.5±0.71	7.3±0.48	7.6±0.84
90	7.0±0.82	7.3±0.48	7.1±0.32	7.4±0.84
S.Em.	0.32	0.20	0.17	0.20
C. D. @ 5%	NS	NS	NS	NS
Overall acceptability				
0	7.9±0.88	7.9±0.88	7.6±0.81	7.6±0.81
30	7.5±1.06	7.5±0.71	7.4±1.30	7.6±0.70
60	7.2±0.42	7.3±0.82	7.1±1.10	7.5±0.71
90	7.0±1.33	7.1±0.32	7.0±0.47	7.4±0.52
S.Em.	0.29	0.3	0.33	0.2
C. D. @ 5%	NS	NS	NS	NS

All results are mean ± standard deviation of three values.
#QPM: RWF+ gluten+ water used for dough making + guar gum-44:44 + 12 g +53 ml + 0.2 g
LDPE= Low Density Polyethylene
S/NS signifies significant and non-significant difference, respectively. S.Em. - standard error of mean, C.D.- critical difference

Shobha *et al.* (2015) [13] reported that QPM noodles and control noodles showed maximum overall acceptability score upto three months of storage.

Microbiological quality

The microbial study was conducted by taking total viable count of optimized QPM noodles and RWF noodles at every 30 days for three months of storage period (Table 5). The total viable count of QPM incorporated noodles in LDPE was 12.0 × 10^2 cfu/g and in aluminum laminated packets was 9.0 × 10^2 cfu/g during three months of storage period which was initially found to be 5.0 × 10^2 cfu/g. In refined wheat flour noodles the initial total viable count was 4.3 × 10^2 cfu/g and after three months of storage the total viable count in LDPE was 10.0 × 10^2 cfu/g and in aluminum laminated packets was 8.2 × 10^2 cfu/g. The studies indicated that the formulated noodles packed in the selected packaging materials had microbial load within the permissible limits at room temperature throughout the storage period, which showed the stability of the product. According to BIS, standard plate count of 50,000 cfu/g has been specified for high protein mixes (ISI, 1974) [14] and ready to eat rich extruded snacks (ISI, 1980) [15].

Table 5: Total viable count (cfu/g) of optimized QPM noodles and control refined wheat flour noodles during storage

Storage period	Optimized QPM noodles#		RWF noodles	
	LDPE	Aluminum laminated packets	LDPE	Aluminum laminated packets
0	5.0 × 10^2	5.0 × 10^2	4.3 × 10^2	4.3 × 10^2
30	7.2 × 10^2	6.9 × 10^2	5.8 × 10^2	4.3 × 10^2
60	8.0 × 10^2	7.7 × 10^2	7.8 × 10^2	6.6 × 10^2
90	12.0 × 10^2	9.0 × 10^2	10.0 × 10^2	8.2 × 10^2

#QPM: RWF+ gluten+ water used for dough making + guar gum-44:44 + 12 g +53 ml + 0.2 g
LDPE= Low Density Polyethylene

Conclusion

Present study indicated that there was a non-significant increase in moisture, peroxide value and free fatty acid value of QPM noodles and RWF noodles, respectively upto 3 months of storage. There was also no significant difference in sensory qualities of QPM and RWF noodles in both types of packaging materials i.e., LDPE and aluminum laminated packets as both were acceptable upto 3 months and microbial load also within the permissible limits throughout the storage period. The main reason behind the good storage stability of noodles was presence of low moisture content.

References

1. Ruiz JR, Ayala AM, Drago S, Gonzalez R, Ancona DB, Guerrero LC. Extrusion of a hard-to-cook bean (*Phaseolus vulgaris* L.) and quality protein maize (*Zea mays* L.) flour blend. LWT-Food Science and Technology 2008;41:1799-1807.
2. Pakhare KN, Dagadkhair AC, Udachan IS, Andhale RA. Studies on preparation and quality of nutritious noodles by incorporation of defatted rice bran and soy flour. Journal of Food Processing and Technology 2016;7:629. Doi: 10.4172/2157-7110.1000629.

3. Kumar S, Khanna N, Vaquil, Bishnoi S, Yadav S. Evaluation of sensory quality of chicken enriched noodles during storage at ambient temperature. The Pharma Innovation Journal 2019;8(9):82-85.
4. Earle M, Earle R. Case Studies in Food Product Development. CRC Press, Boca Raton, 2008.
5. Komolafe EA. Food packaging. A monograph. Publisher: Biotidara press and computers, Akure (Ondo state) Nigeria 2005, 81.
6. Shobha D, Pradannakumar MK, Puttaramanaik, Sreemastty TA. Effect of antioxidant on the shelf life of quality protein maize flour. Indian Journal of Fundamental and Applied Life Sciences 2011;1(3):129-140.
7. Dixit A, Chaudhary V. β-carotene rich noodles: Optimization and development using response surface methodology. Food Science Research Journal 2017;8(2):138-145.
8. A.O.A.C. Official Methods of Analysis, Association of Official Analytical Chemists. 17th ed Washington D.C., 1995.
9. A.O.C.S. Official Methods and Recommended Practices of the American Oil Chemists' Society. 5th ed., AOCS Press, Champaign, Illinois 1997.
10. A.P.H.A. Compendium of methods for microbiological examination of foods. Washington. America Public Health Association 1984, 919-927.
11. Isengard HD. Water content, one of the most important properties of food. Food Control 2001;12(7):395-400.
12. Kaur H, Bobade H, Singh A, Singh B, Sharma S. Effect of formulations on functional properties and storage stability of nutritionally enriched multigrain pasta. Chemical Science International Journal 2017;19(1):1-9.
13. Shobha D, Vijayalakshmi D, Puttaramnaik, Asha KJ. Effect of maize based composite flour noodles on functional, sensory, nutritional and storage quality. Journal of Food Science and Technology 2015;52(12):8032–8040.
14. ISI 1974. IS: 3137, Specification for high-protein mixes for use as food supplements. Bureau of Indian Standards, New Delhi.
15. ISI 1980. IS: 9487, Specification for 'ready-to-eat' protein-rich extruded snacks. Bureau of Indian Standards, New Delhi.