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Studies on effect of diffrent storage periods on quinoa incorporated whole wheat flour biscuits

Godase SN[1], Kotecha PM[2], UD Chavan[3]
[1-3] Department of Food Science and Technology MPKV Rahuri, Maharashtra, India

Abstract
Sensory properties of bakery product play an key role in product quality and overall acceptance moreover the textural properties are also playing an vital role in product quality and acceptability. Hence the entire present investigation was carried out to determine the effect of incorporation of quinoa flour on various sensory and textural properties of biscuits over the various storage period. Hence the present storage study of biscuits was carried out for 90 days with silver aluminum foil and it shown its effect on quality of final product of various storage period. finally, it was found that the biscuit with silver aluminum foil shown that product having good quality up to 90 days and also good acceptance. however it was found that storage period increase over 90 days leads to decrease quality of product like colour, texture, taste etc moreover it was also found that the the biscuit made from quinoa flour incorporation up to 25% shown superior quality than the biscuit made from whole wheat flour hence it could can conclude that quinoa flour given positive superior impact on product quality over whole wheat flour as shelf life point of view along with sensory parameter.

Keywords: textural, quinoa flour, whole wheat flour, storage period

Introduction
India is currently the world's largest biscuit consuming nation. The industry is expected to grow at a CAGR of 14 per cent till financial year 2019.The top four players in the market for biscuits and cookies are Parle Products, Britannia, ITC and Surya Foods and Agro. Biscuit are easier to manufacture, have a long shelf life, are easier to transport and can be available everywhere. It is also profitable to sell in rural areas if the pricing of the packet is low and size is individual. Bakery industry has a very important role to play in economic development of the country and also in building the health of people. The nutritional significance of the bakery products is well recognized. Attempts are being made to enrich the products with high quality non-wheat flours, which are ready to eat, convenient, inexpensive. To attract consumers, traditional products must be reformulated to meet demands for fast preparation time, convenience and health significance. Biscuits and Cake formulation offers an easiest opportunity of fortification of other cereals, oilseed and legumes flour for product preparation. Quinoa (*Chenopodium quinoa Willd*) belongs to family Cheno podiaceae, class Dicotyledoneae, genus Cheno podium, and species quinoa. Quinoa is a dicot plant that can grow from 1 to 3 m high, it is considered a pseudo-cereal, not a true grain but rather a fruit. The seeds are round and flat, about 1.5-4.0 mm in diameter and their color varies from white to grey and black, with tones of yellow, rose, red, purple and violet. Quinoa has demonstrated a strong tolerance to salty, acid or alkaline soils, in both cold (-5°C) or hot climates (up to 35°C). The major quinoa producing countries are Bolivia, Peru and Ecuador. Outside South America, quinoa is grown in the USA (Colorado and California) and in Canada. It is also cultivated experimentally in Finland and the UK. Quinoa grains have an established excellent nutritional food quality and also called “the chisya mama or mother grain” and is nowadays also called Incan rice (Taylor and Parker, 2002). Quinoa is considered one of the best vegetal protein sources, as its protein levels are similar to those found in milk and higher than those present in cereals such as wheat, rice and maize. Quinoa flour is low in gluten due the low contents of prolamines and glutamines. The seed protein content is high (about 15%), and its essential amino acid balance is excellent because of a wider amino acid spectrum than cereals and legumes (Ruales and Nair, 1992), with higher lysine (5.1- 6.4%) and methionine (0.4-1.0%) contents (Bhargava *et al*., 2003) [1]. It is an important source of vitamins and minerals, Quinoa grains have vitamins C, E (tocopherols) and B complex and important minerals (Ca, K, Fe, Mg, Mn, P), and has also been found to contain compounds like polyphenols, phytosterols and flavonoids with possible nutraceutical benefits, isoflavons and high quality lipids. Starch is the major component of quinoa, comprising approximately 55% of the seed. It is present in the form of small granules about 1.5 µm in diameter (Chauhan *et al*., 1992) [3]. Wheat (*Triticum aestivum*) belongs to family graminae. In India wheat is grown in 30.59 million hectare area with 98.51 million tons production and productivity of 3216 kg/ha (Anonymous, 2017). Wheat contains about, protein 12 per cent, carbohydrate 71.2 per cent, mineral 1.5 per cent and Fiber 1.2 per cent but is deficient in the essential amino acid lysine. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber. In a small part of the general population, gluten – the major part of wheat protein can trigger celiac disease, non-celiac gluten sensitivity, and gluten ataxia and dermatitis herpetiformis. Global demand of wheat is increasing due to the unique viscoelastic and adhesive properties of gluten proteins, which facilitate the production of processed foods, whose consumption is increasing as a result of the worldwide industrialization process and the westernization of the diet.

In India, wide ranges of traditional foods are consumed as breakfast items. To attract consumers, traditional products must be reformulated to meet demands for fast preparation

time, convenience and health significance. Biscuits, Cakes formulation offer an easiest opportunity of fortification of other cereals, oilseed and legumes flour for product preparation.

Earlier work done reveals that the bakery products prepared from composite flour lacked the spread and had a poor top gain character; they were dense, compact, gritty and mealy in taste. Studies related to incorporation of various levels of sugar, shortening, ammonium bicarbonate, skimmed milk powder and baking powder in baked product preparation have been reported by many worker (Warraky *et al*., 1980 [8], Khovanskaya and Shathyuk, 1983) [5]. The information of optimum level of quinoa flour to wheat flour and baking ingredient their individual, interactive, quadratic effect on biscuit and cake quality parameters is quiet meager which requires systematic investigation.

Materials and Methods

The entire present investigation was carried out at department of food science and technology MPKV Rahuri.

The raw material requied for processing like wheat. (phule samadhan) was purchased from wheat research station niphad nashik along with that quinoa flour was purchased from JNKVV Jabalpur (M.P.) and silver aluminum foil and other trace materials were purchase from local market of rahuri.

Methods

Preparation of quinoa flour

3.2.2. Preparation of quinoa flour

3.2.2.1 Cleaning

The quinoa grains were cleaned manually to remove dirt, dust, mud, plant debris, stone and chaff materials etc. The quinoa grains could not be consumed directly without its processing because the quinoa seed are bitter in taste due to presence of saponin in seed pericarp. Therefore, it is essential to remove saponins from endosperm to minimize the harmful effect to the body. Following cold and hot water treatment method was adopted to remove saponin

3.2.2.2. Cold water treatment

The required measured quantity of quinoa grains was soaked water kept in steel pot for 20 min. The low weight quinoa grain floating over the surface of water were removed with the help of sieves. The quinoa grains were washed in tap water (cold) for 12 to 13 times until the there was no more foam in the washing water. The washed quinoa seed were spread smoothly in thin layer on the muslin cloth put on the aluminum tray. The excessive water was drained out. The treated quinoa grains were sun dried for 24 hrs. (Fig.3.1).

3.2.2.3 Hot water treatment

After cold water treatment the quinoa grains were dipped in hot water at 80^0 C for 20 min in stainless tank. The content was starred for five to six time to remove the adhering hull of quinoa grain. The excess water was drained out and grains were shifted over aluminum trays for sun drying for two days. The treated quinoa grains were dried and grinded in Electric Kohinoor flour Mill. The flour was passed through 60 mesh sieve to get uniform. Particles size of quinoa flour. The flour was packed in air tight plastic container and stored at ambient temperature for further utilization for biscuit and cake product development.

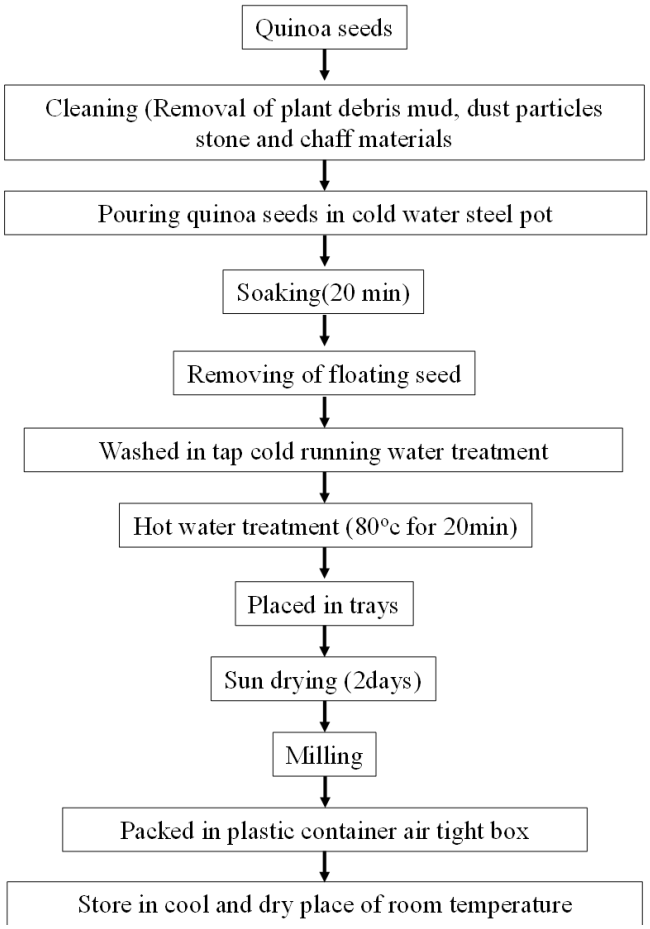

Fig 1: Flow chart for preparation of quinoa seedflour

Results and discussion

Storage study of optimized product (Expt. 29) and whole wheat flour (Control) biscuit

The biscuits were packed in aluminum silver foil and stored at ambient temperature for 3 months (90 days). The biscuits were evaluated for proximate composition, mineral nutrients, textural properties (Hardness), sensory quality attributes and microbial study. The findings of investigations are given in Table 4.26 to 4.40 depicted through

4.6.1 Moisture

The results on changes in moisture content of biscuits during storage are presented in Table 4.26. It was observed that, moisture content increased in control and optimized product from 4.79 to 4.87 percent and 3.79 to 84 percent respectively during 0 to 90 days of storage period. The mean value of moisture content was higher in whole wheat flour (Control) biscuit as compared to optimized product (Expt.29). The t-statistics shows that significant difference exists among the treatment means of products for moisture content at 0.01percent confidence level. the increase in moisture content during storage have also been reported (Nagi *et al.*, 2012, Dutta *et al.*,2018) [4].

Table 1: Moisture content of best optimized product (Expt.29) and whole wheat flour (control) biscuit, under varying storage period

S.N.	Product	Moisture (%)			
		0 days	30 days	60 days	90 days
1	Control	4.79	4.81	4.84	4.87
2	Optimized Product (Expt.29)	3.79	3.80	3.82	3.84
3	t- statistics	38.729	64.81302	79.00886	57.51087
4	t-table value	2.776	2.776445	2.776445	2.776445
5	P – value	2.65E-06	3.39E-07	1.54E-07	5.47E-07

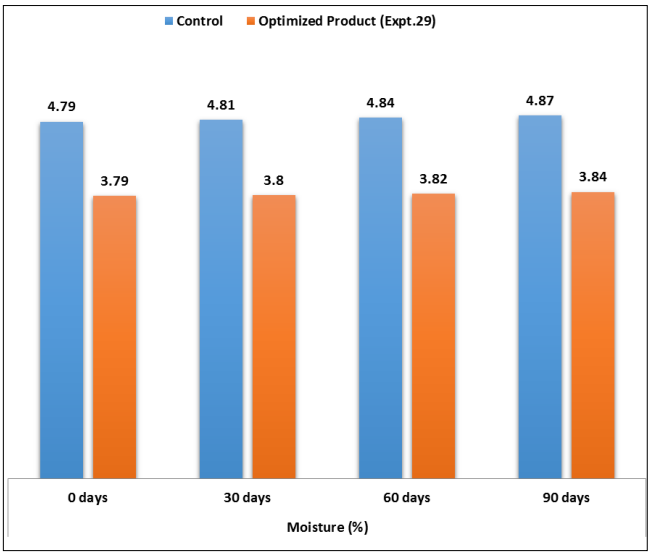

Fig 2: Moisture content of best optimized product (Expt.29) and whole wheat flour (control) biscuit, under varying storage period

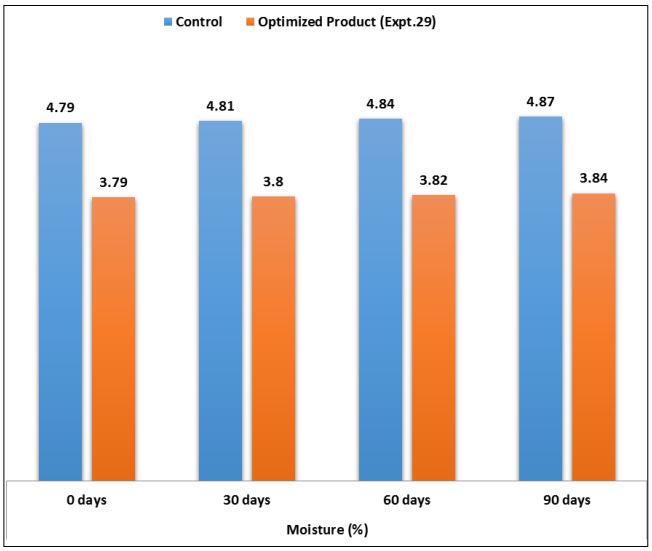

Fig 3: Crude Protein content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.6.2 Crude Protein

Table 4.27 comprises the results of changes in protein content of biscuits during storage. It was observed that, protein content was decreased in control and optimized product from 10.50 to 9.50 percent and 13.13 to 13.00 percent respectively during 0 to 90 days of storage period. The mean value of crude protein content was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics exhibits a significant difference among the treatment means of products for crude protein content at 0.01percent confidence level. The change in protein content in biscuits during storage study is might be due to the increase in moisture content of product. As such no information is available in the literature on nutritional quality of biscuits during storage; therefore, the findings of present investigation could not be substantiated with the reported results.

Table 2: Crude Protein content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Crude Protein (%)			
		0 days	30 days	60 days	90 days
1	Control	10.50	10.20	9.98	9.95
2	Optimized Product (Expt.29)	13.13	13.10	13.07	13.00
3	t- statistics	45.587	86.142	99.384	17.369
4	t-table value	2.776	2.776	2.776	2.776
5	P – value	1.38E-06	1.09E-07	6.15E-08	6.45E-05

4.6.3 Crude Fat

A perusal of table 4.28 indicates that crude fat content during storage varied from 17.4 to 16.84 and 19.50 to 18.79 percent in control and optimized product respectively during 0 to 90 days of storage period. The mean value of fat content was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics exhibits a significant difference among the treatment means of products for crude fat content at 0.01percent confidence level. The change in fat content in biscuits during storage study is might be due to the increase in moisture content of product. The findings of decrease in fat content during storage could not be substantiated due to unavailability of reported results.

Table 3: Crude Fat content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Crude Fat (%)			
		0 days	30 days	60 days	90 days
1	Control	17.4	16.97	16.89	16.84
2	Optimized Product (Expt.29)	19.50	18.98	18.80	18.79
3	t- statistics	56.805	108.122	45.876	67.550
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	5.75E-07	4.39E-08	1.35E-06	2.88E-07

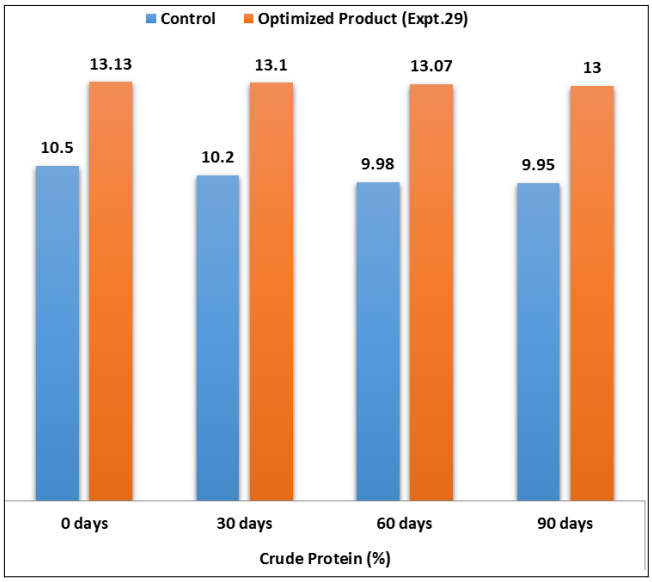

Fig 4: Crude Fat content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.6.4 Carbohydrate

Table 4.29 comprises the results of changes in carbohydrate content of biscuits during storage. It was observed that, carbohydrate content was decreased in control and optimized product from 65.98 to 65.80 per cent and 60.80 to 60.00 percent respectively during 0 to 90days of storage period. The mean value of carbohydrate content was higher in whole wheat flour (Control) biscuit as compared optimized product (Expt.29). The t-statistics exhibits a significant difference among the treatment means of products for carbohydrate content at 0.01 per cent confidence level. The change in carbohydrate content of biscuits during storage study is might be due to the increase in moisture content of product. The findings of decrease in carbohydrate content during storage could not be substantiated due to unavailability of reported results.

Table 4: Carbohydrates content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Carbohydrates (%)			
		0 days	30 days	60 days	90 days
1	Control	65.98	65.95	65.89	65.80
2	Optimized Product (Expt.29)	60.80	60.50	60.20	60.00
3	t- statistics	166.600	175.290	197.107	19.277
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	7.79E.-09	6.35E-09	3.97E-09	4.27E-05

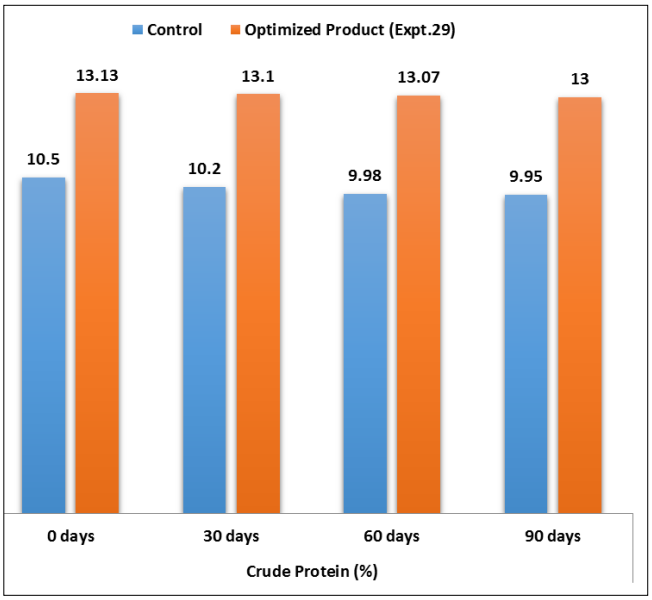

Fig 5: Carbohydrates content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.6.5 Crude Fiber

A cursory view of table 4.30 indicates that mean value of crude fiber content was decreased in control and optimized product (Expt.29) from0.60 to 0.56 percent and 0.90 to 0.87 per cent respectively during 0 to 90 days of storage period. The mean value of crude fiber content was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics shows that significant difference exists among the treatment means of products for moisture content at 0.01percent confidence level. The findings of slight decrease in crude fiber content during storage could not be substantiated due to unavailability of reported results.

Table 5: Crude Fiber content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Crude Fiber (%)			
		0 days	30 days	60 days	90 days
1	Control	0.60	0.59	0.57	0.56
2	Optimized Product (Expt.29)	0.90	0.89	0.88	0.87
3	t- statistics	8.911	11.619	14.891	14.891
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.000877	0.000314	0.000118	0.000118

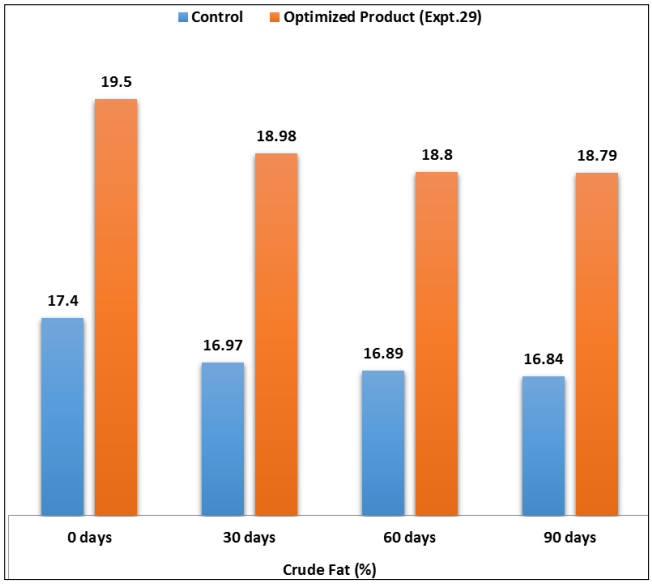

Fig 6: Crude Fibre content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.6.6 Ash Content

The ash content of biscuits during storage is presented in Table 4.31. It was observed that, ash content was decreased in control and optimized product from 0.73 to 0.64 percent and 1.98 to 1.89 percent respectively during 0 to 90 days of storage period. The mean value of ash content was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics exhibits a significant difference among the treatment means of products for crude protein content at 0.01percent confidence level. The findings of slight decrease in Ash content during storage could not be substantiated due to unavailability of reported results, however its concentration is similar as its content in quinoa grain.

Table 6: Ash content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Ash (%)			
		0 days	30 days	60 days	90 days
1	Control	0.73	0.69	0.66	0.64
2	Optimized Product (Expt.29)	1.98	1.96	1.93	1.89
3	t- statistics	60.048	49.186	62.450	48.412
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	4.61E-07	1.02E-06	3.94E-07	1.09E-06

4.6.7 Phosphorous and Magnesium Content

Table 4.32 and 4.33 comprises the results of phosphorus and magnesium content of biscuits during storage. The phosphorus and magnesium content varies from 87 to 85 and 118.50 to 112.35 mg/100g in control and optimized product respectively during 0 to 90 days of storage period. The mean value of phosphorus and magnesium content were higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics exhibits a significant difference among the treatment means of products for crude protein content at 0.01 per cent confidence level. The findings of slight decrease in phosphorus and magnesium content during storage could not be substantiated due to unavailability of reported results, however their concentration is similar as its content in quinoa grain.

Table 7: Phosphorus content of optimized product (Expt. 29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Phosphorus (mg/100g)			
		0 days	30 days	60 days	90 days
1	Control	87	87	86	85
2	Optimized Product (Expt.29)	118.50	117	115.22	112.35
3	t- statistics	26.465	23.237	16.825	22.478
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	1.21E-05	2.03E-05	7.31E-05	2.32E-05

Table 8: Magnesium content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Magnesium (mg/100g)			
		0 days	30 days	60 days	90 days
1	Control	85	84	82	80
2	Optimized Product (Expt.29)	89	89	86	85
3	t- statistics	4.898	7.745	9.797	14.852
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.00805	0.001496	0.000608	0.00012

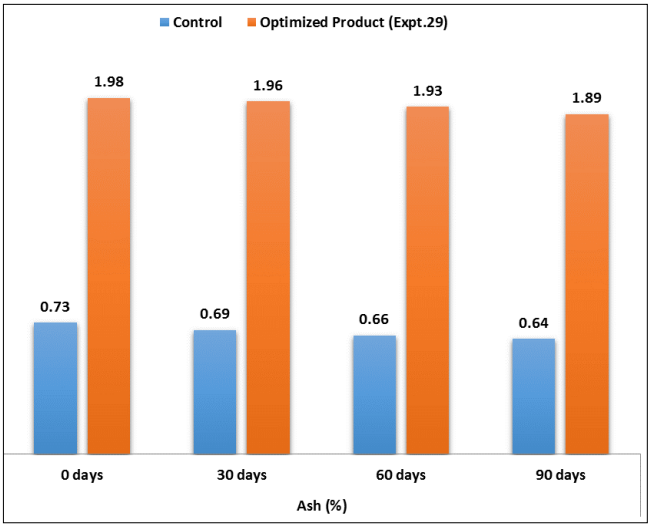

Fig 7: Ash content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

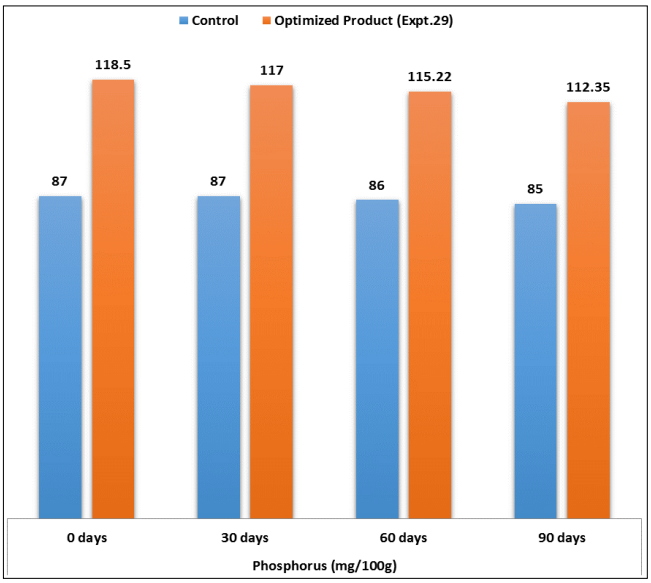

Fig 8: Phosphorus content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

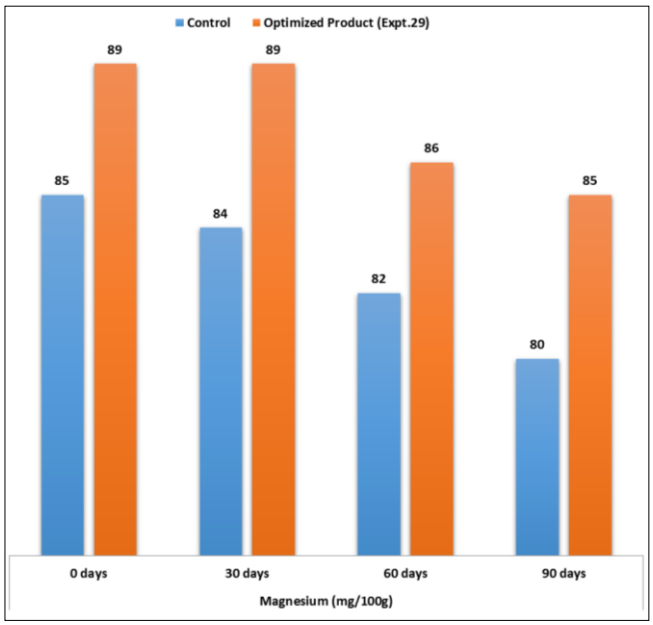

Fig 9: Magnesium content of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

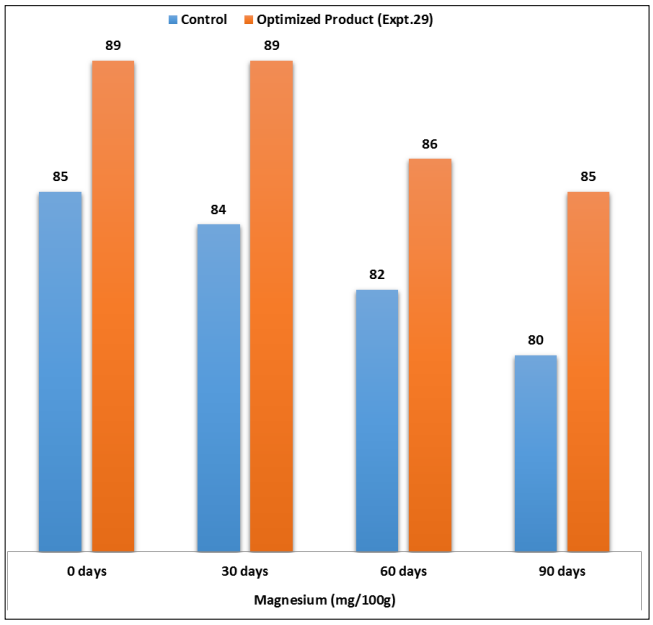

Fig 10: Textural properties (Hardness) of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.7 Textural properties (Hardness) of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.7.1 Hardness

A cursory view of table 4.34 indicates the mean value of hardness of biscuits. It was observed that maximum force required to break the biscuits was decreased during storage. The hardness value of control and optimized product (Expt.29) were found to be 76 to 70.10 and 51.29 to 48.23 N respectively during 0 to 90days of storage period. The mean value of hardness was higher in whole wheat flour (Control) biscuit as compared to optimized product (Expt.29). The results of t-statistics were also significant for the treatment means of products at 0.01 per cent confidence level. The present findings are nearer to the reported results of Chavan *et al.*, (2016).

Table 9: Textural properties (Hardness) of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Hardness(Force max N)			
		0 days	30 days	60 days	90 days
1	Control	76.00	74.20	72.12	70.10
2	Optimized Product (Expt.29)	51.29	50.16	49.21	48.23
3	t- statistics	85.325	18.667	3.882	18.815
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	1.13E-07	4.85E-04	0.017807	4.7E-05

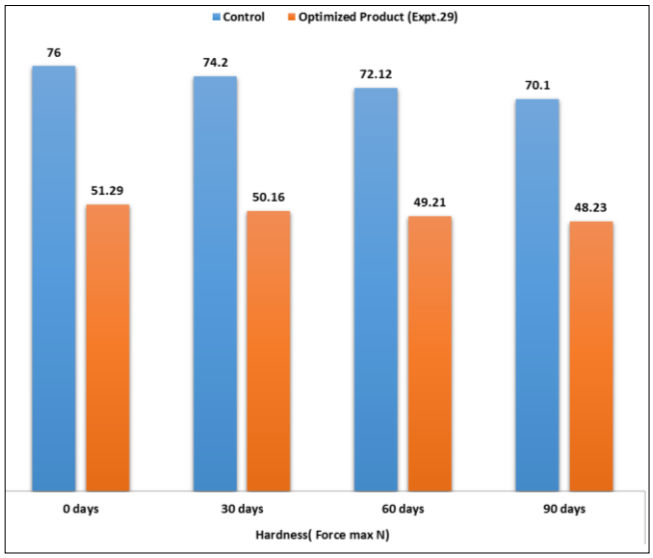

Fig 11: Sensory quality attributes of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.8.1 Color and Appearance

The results on changes in colour and appearance of biscuits during storage are presented in Table 4.35. It was observed that, colour and appearance score was decreased in control and optimized product from 8.70 to 8.32 and 9.00 to 8.62

Respectively during 0 to 90days of storage period. The mean value of colour and appearance score was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics shows that non-significant difference was observed among the treatment means at zero days of storage, however it was significant at 30, 60 and 90 days' storage of products at 0.01percent confidence level. The similar findings of color and appearance are also reported by Nisar *et al.*, (2018) [7].

Table 10: Color and appearance of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Color and Appearance			
		0 days	30 days	60 days	90 days
1	Control	8.70	8.60	8.45	8.32
2	Optimized Product (Expt.29)	9.00	8.92	8.74	8.62
3	t- statistics	1.441	2.717	6.762	14.411
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.222983	0.053126	0.002494	0.000135

4.8.2 Texture

Table 4.36 comprises the results of changes in texture score of biscuits during storage. It was observed that, texture score was decreased in control and optimized product from 8.10 to 7.70 and 8.40 to 7.98 respectively during 0 to 90 days of storage period. The mean value of texture score was higher in optimized product (Expt. 29) as compared to whole wheat flour (Control) biscuit. The t-statistics shows that non -significant difference was observed among the treatment means at 30 days of storage, however it was significant at 0, 60 and 90days storage of products at 0.01percent confidence level. The present findings are in conformity with reported results of Nisar *et al.*, (2018) [7].

Table 10: Texture of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Texture			
		0 days	30 days	60 days	90 days
1	Control	8.10	8.00	7.91	7.70
2	Optimized Product (Expt.29)	8.40	8.20	8.12	7.98
3	t- statistics	9.649	0.960	8.133	9.005
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.000645	0.391076	0.001243	0.000842

4.8.3 Crispiness

A perusal of table 4.37 indicates findings of crispiness score of biscuits during storage. It varied from 8.30 to 7.00 and 8.60 to 8.12 in control and optimized product respectively during 0 to 90 days of storage period. The mean value of crispiness score was higher in optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics shows that non -significant difference was observed among the treatment means at 0 and 30 days of storage, however it was significant at 60 and 90 days' storage period of products at 0.01 per cent confidence level. The reported results could not be substantiated due to unavailability of reported results.

Table 11: Crispiness of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Crispiness			
		0 days	30 days	60 days	90 days
1	Control	8.30	8.18	8.09	7.00
2	Optimized Product (Expt.29)	8.60	8.48	8.29	8.12
3	t- statistics	2.520	1.011	6.123	9.651
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.065322	0.369048	0.003602	0.000645

4.8.4 Taste

Table 4.38 comprises the results of changes in taste score of biscuits during storage. It was observed that, taste score was decreased in control and optimized product from 8.84 to 8.22 and 9.00 to 8.70 respectively during 0 to 90 days of storage period. The mean value of taste score was higher in optimized product (Expt.29) as compared whole wheat flour (Control) biscuit. The t-statistics shows that non -significant difference was observed among the treatment means at 0 and 30 days of storage, however it was significant at 60 and 90 days' storage period of products at 0.01percent confidence level. The present findings are in conformity with reported results of Nisar *et al.*, (2018) [7].

Table 12: Taste of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Taste			
		0 days	30 days	60 days	90 days
1	Control	8.84	8.63	8.47	8.22
2	Optimized Product (Expt.29)	9.00	8.90	8.82	8.70
3	t- statistics	1.358	2.312	11.257	41.136
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.245802	0.081816	0.000355	0.01442

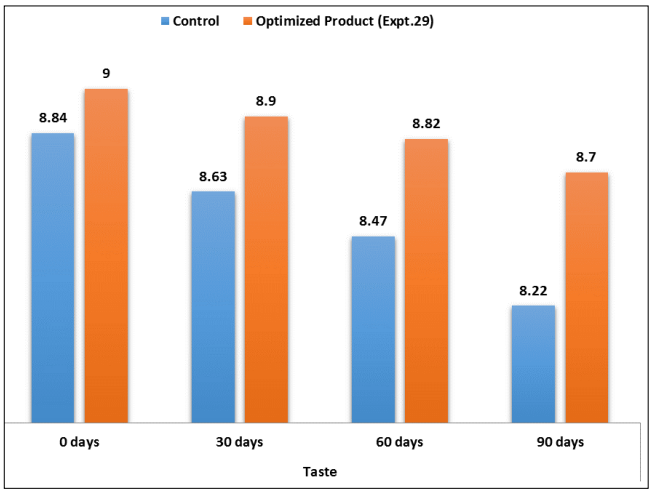

Fig 12: Overall Acceptability of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

4.8.5 Overall Acceptability

A cursory view of table 4.39 indicates that mean value of overall acceptability score was decreased in control and optimized product (Expt.29) from 8.48 to 7.81 and 8.75 to 8.35 respectively during 0 to 90 days of storage period. The mean value of overall acceptability score was higher in

optimized product (Expt.29) as compared to whole wheat flour (Control) biscuit. The t-statistics shows that significant difference exists among the treatment means of products for overall acceptability score at 0.01 per cent confidence level. The present findings are in conformity with reported results of Nisar *et al.,* (2018) [7].

Table 13: Overall Acceptability of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

S.N.	Product	Overall Acceptability			
		0 days	30 days	60 days	90 days
1	Control	8.48	8.35	8.23	7.81
2	Optimized Product (Expt.29)	8.75	8.62	8.49	8.35
3	t- statistics	8.020	8.684	9.006	16.040
4	t-table value	2.776	2.776	2.776	2.776
5	P - value	0.001311	0.000968	0.000841	8.83E-05

4.9 Microbial study of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

The results of microbial study of optimized product (Expt.29) and whole wheat flour (Control) biscuit are presented in table 4.40. The microbial counts of products were taken at initial zero day and 90 days of storage. The finding indicates that at initial zero day no yeast and mould count were detected. At 90 days of storage 1 and 2 $X10^3$ cfu/g yeast and mould count was observed control and optimized product respectively. The findings indicate that product contain very low level of yeast and mould count, therefore product is found fit for consumption. Nisar *et al.,* (2018) [7] and Dutta *et al.,* (2018) [4] also reported the similar results.

Table 14: Microbial counts of optimized product (Expt.29) and whole wheat flour (Control) biscuit, under varying storage period

Product	Yeast and Mold count (- $X10^3$ cfu/g)	
	Initial (o days)	Final (90 days)
Control	ND	1
Optimized Product (Expt.29)	ND	2

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