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RESEARCH PAPER

Effect of Buck Wheat and HACCP in improving the nutritional quality and storage stability of *"Kulcha"*

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Abstract

Out of traditional cuisines of Kashmir baked foods are very popular. One of the major product of this ingenuity is *Kulcha*, which over time has evolved and established as an important traditional bakery product. The product was prepared after fortifying with 5, 10, 15, 20% buck wheat flour and was stored for 50 days to ascertain the changes in nutritional composition and storage stability. The formulation was done by two methods with HACCP and without HACCP. The highest moisture (3.76%) and total sugar (13.41%) was shown by the flour combination of wheat: buck wheat; 100:0 at 50 days of storage whereas, the highest protein (9.41%), fat (23.97%) and fiber (6.75%) was observed in flour combination of wheat: buck wheat; 80:20 at 0 days of storage. However the highest fungal count of 3.920 log cfu/gm was recorded in flour combination (wheat: buck wheat; 100:0) at 50 days of storage in product prepared without HACCP.

Keywords: Buck wheat, fungal count, HACCP, *Kulcha*, traditional food, gluten, wheat, Alkaline water retention capacaity

Buckwheat (*Fagropyrum esculentum*) rain is a pseudocereal food crop in the dicot family Polygonaceae having variety of healthful properties. It is gluten free, high in fiber and is an excellent plant source of easily digestible protein and contains all the eight essential amino acids. Buckwheat is used in various food products including porridges, breads, cookies, tortillas, and extruded commercial products (Akpe *et al.* 2010).

In Jammu and Kashmir, the traditional bakery industry is very popular. In this changing life style of economic consideration, westernization, urbanization, busy life, increased women employment and *per capita* income, the consumer demand is increasing for composite flour based bakery products (James *et al.* 2004). The growing interest in these types of bakery products is due to their better nutritional properties, their easy availability and use (Hooda and Jood, 2005). However, to prevent the physical, chemical and microbial spoilage of the bakery the product formulation application of HACCP (Hazard Analysis and Critical Control Point) protocols (Anil *et al.* 2010) has been advocated. HACCP is an internationally recognized system of ensuring food safety. It provides a scientifically based systematic approach to the identification, evaluation, and control of food safety hazards, where the critical steps in food or ingredient preparation where contamination is most

likely to occur are identified and then, put in place preventive the controls to eliminate or reduce food safety hazards to acceptable levels (Williams and Paustenbach, 2002).

Kulcha, a traditional bakery food of Kashmir, is a type of cracker made from maida (wheat flour) with nuts and poppy seed topping. It is particularly popular in Jammu and Kashmir, India and Lahore, Pakistan, and is usually eaten with *kehwa* (the traditional Kashmiri green tea) (Joshi, 2016). Monitoring food quality and safety from raw materials to finished products is of great importance to the food industry (Pratima and Yadav, 2000).

Keeping this in view the underutilised local crop Buckwheat (*Fagropyrum esculentum*) grown in Gurez area of Kashmir, having nutraceutical properties used in *Kulcha* formulation and to study the effect of HACCP protocol on safety aspects and storage stability of the product. The results are described in this paper.

Material and Methods

Raw Material

Wheat (Shalimar wheat-1) was procured from the division of Genetics and Plant Breeding, SKUAST, Kashmir. Buck wheat was purchased from the Global Trading Jagadhari, Haryana, India. The wheat flour used for product formulation was fancy clear flour (55% extraction rate), while as, buck wheat flour used was straight run flour (100% extraction rate). The milling was done in Buhler Pneumatic Mill (MLU-202, Buhler Bros, Inc, UZWIL, Switzerland)

Preparation of Traditional *Kulcha*

The product was formulated using two different techniques, with HACCP and without HACCP. The process for preparation of *Kulcha* using flour of wheat was made using creaming method (Singh *et al.* 2005). *Kulcha* was prepared from wheat and buck wheat flour in the ratios of 100:0 (F_0), 95: 5 (F_1), 90:10 (F_2), 85:15 (F_3), 80:20 % (F_4). In this method, all the fat and sugar was creamed together adding sugar gradually. Then flour was added in the mixture. Flour was mixed with baking powder. The flour was mixed with batter in mixer at a slow speed in order to achieve appropriate texture of batter. Then, the eggs which were whipped prior, were added followed by addition of milk, milk powder and salt. The batter was then, sheeted and the poppy seeds were sprinkled on it. The sheet of batter was then, cut into the desired shape with the help of cutter, and baked at 150°C for 35 min, followed by cooling at ambient temperature and packing. HACCP analysis with reference to *Kulcha* formulation was obtained from (as detailed in the following table) Harvest Gold Industries Pvt. Ltd., Tapokda, Gurgaon, India.

Table 1: Physico-chemical composition of wheat and buck wheat flour

Parameters	Flour type	
	Wheat (55%ER)	Buck Wheat (100%ER)
Moisture(%)	12.36	11.12
Protein (%)	8.07	11.97
Fat (%)	1.84	1.95
Ash (%)	1.31	1.80
Fiber (%)	0.72	2.36
%Water absorption	58.25	30.4
Peak viscosity (cp)	3390	1080
Dough development time (min)	1.62	2.50
Wet Gluten (%)	25.42	Gluten Free

ER- Extraction Rate; cp- centipoise (12 centipoise (cp) = 1 rapid visco units (RVU))

Proximate analysis of wheat-buck wheat Kulcha

Thickness and diameter of Kulcha was measured by using Vernier callipers. Spread ratio was calculated by dividing diameter with thickness whereas weight loss before and after baking was calculated by using weighing balance (AACC, 1990). Moisture, crude fibre, crude protein (Microkjeldal process using 6.25 for converting nitrogen content into crude protein) and crude fat (in Soxhlet extraction apparatus using petroleum ether as a solvent) were determined

according to the AOAC methods (1995). Per cent water absorption was evaluated on a farinograph where the curve was centered on the 500 brabender unit while as peak viscosity is recorded by rapid visco analyser (AACC, 2000).

Sugars were determined by potassium ferricyanide method where 5.675 g flour of each treatment was extracted with sodium acetate buffer (50 ml) followed by immediate addition of sodium tungstate solution (2 ml, 12%) and results were expressed as per cent glucose (AACC, 1990). The samples were tested for their Alkaline Water Retention Capacaity (AWRC) according to the procedure outlined by AACC (2000). One gram sample was suspended in 5 ml of 0.1 N $NaHCO_3$ hydrated for 20 min and centrifuged at 1000 g for 15 min at room temperature. The precipitates obtained were weighed and AWRC (Alkaline Water Retention Capacity) was calculated.

Microbial analysis

Fungal count was determined during a storage period of 50 days with an interval of 10 days by the method of serial dilution technique using Potato Dextrose Agar media. The incubation period was 48 hours at 25±2°C. The colonies so formed were expressed in log cfu/g (Karuna and Kolte, 2005).

Statistical analysis

The data obtained (in triplicate) were evaluated statistically with OPSTAT package program (OPSTAT software for Windows) by variance analysis. When variance analysis showed significant difference ($p<0.05$) among the means, the least difference test was used to evaluate means.

Results and Discussion

Physico-chemical composition of wheat and buck wheat flour

Significant differences were observed in various physico-chemical characteristics (Table 1). Highest protein (11.97%), fat (1.95%), ash (1.80%), fiber (2.36%), dough development (2.50 min) were recorded in buck wheat flour. However wheat flour depicted highest % water absorption of 58.25%, peak viscosity of 3390 cp, wet gluten of 25.42% and moisture of 12.36%. Buck wheat is separately rich in fibers, calcium, iron, vitamins and essential amino acids (lysine, threonine

Table 2: Effect of flour combinations on physical characteristics of traditional *Kulcha*

	Diameter (mm)		Thickness (mm)		Spread ratio		Weight loss (g)	
Treatments	**Before baking**	**After baking**	**Before baking**	**After baking**	**Before baking**	**After baking**	**Before baking**	**After baking**
H_0F_0	70	73.92	10	11.38	7.00	6.495	Not applicable	96.62
H_1F_0	70	73.90	10	11.38	7.00	6.493	"	96.63
H_0F_1	70	73.77	10	11.39	7.00	6.476	"	96.70
H_1F_1	70	73.75	10	11.39	7.00	6.474	"	96.71
H_0F_2	70	73.52	10	11.41	7.00	6.443	"	96.76
H_1F_2	70	73.51	10	11.42	7.00	6.436	"	96.78
H_0F_3	70	73.35	10	11.43	7.00	6.422	"	96.81
H_1F_3	70	73.34	10	11.42	7.00	6.422	"	96.82
H_0F_4	70	73.17	10	11.43	7.00	6.401	"	96.87
H_1F_4	70	73.15	10	11.44	7.00	6.394	"	96.89
Mean	**70**	**73.54**	**10**	**11.40**	**7.00**	**6.445**	**"**	**96.75**

H_0: Products formulated without HACCP protocol; H_1: Products formulated with HACCP protocol

and tryptophan) as compared to wheat (Steadman *et al.* 2001a). But the flour is low in sugars and its bran contains fagropyritols, a galactosyl that is considered useful in the treatment of of non-insulin related diabetes mellitus (Manthey *et al.* 2004). It is gluten free and is an excellent source of easily digestible proteins and contains all the eight essential amino acids, so its close to being a "complete" protein (Franjka and Zeljko, 2003). Therefore, its addition is very useful from nutrition point of view.

Physical Evaluation of traditional *Kulcha*

Table 2 reveals the effect of flour combination and product development formulation (with HACCP [H_1] and without HACCP [H_0]) on physical parameters of *Kulcha*. The highest diameter of 73.92 mm was observed in flour combination (F_0) in product prepared without HACCP and the lowest diameter of 73.15 mm was recorded in flour combination (F_4)in product prepared with HACCP. This is because in product like the cookie diameter dramatically decreases with higher level of damaged starch in both wheat and buck wheat flour (Kumari and Grewal, 2007). However, the maximum and the minimum thickness of 11.44 mm and 11.38 mm was observed in flour combination ($F_{4;}$ in product prepared with HACCP) and ($F_{0;}$ in product prepared without HACCP). The spread ratio varied from 6.495 [flour combination ($F_{0;}$ in product prepared without HACCP)] to 6.394 [flour combination ($F_{4;}$ in product prepared with HACCP)]. The highest weight loss (96.89 g) was observed in flour combination ($F_{4;}$ in product prepared with HACCP)and the lowest weight loss 96.62 g was recorded in flour combination ($F_{0;}$ in product prepared without HACCP). Similar results have been reported by Varshney *et al*. (2008) and Mohamed *et al.* (2009).

Nutritional Evaluation of *Kulcha* prepared with HACCP protocol during storage

Moisture content (%)

The data revealed that the flour combinations and storage periods influenced significantly the moisture content (%) of *kulcha*. The treatment F_0 S_5 (wheat: buckwheat flour %; 100:0; 50 days of storage) recorded the highest moisture content of 3.76% but a lowest of 2.42% was observed in case of treatment F_4S_0 (wheat: buckwheat flour %; 80:20; 0 days of storage). The moisture content decreased with increase in flour combination because of the difference in quantitative distribution of protein fractions and physico-chemical properties of starch in buck wheat flour.

Table 3: Effect of flour combinations and storage periods on moisture (%) of traditional *kulcha*

Storage days	Flour combinations Wheat: buck wheat					Mean
	F_0 (100:0)	F_1 (95:5)	F_2 (90:10)	F_3 (85:15)	F_4 (80:20)	
0 (S_0)	3.59	3.28	2.96	2.76	2.42	**3.00**
10 (S_1)	3.62	3.31	3.00	2.78	2.44	**3.03**
20 (S_2)	3.66	3.34	3.03	2.82	2.47	**3.06**
30 (S_3)	3.69	3.38	3.07	2.85	2.51	**3.10**
40 (S_4)	3.73	3.41	3.10	2.89	2.55	**3.13**
50 (S_5)	3.76	3.44	3.14	2.93	2.58	3.17
Mean	3.67	3.36	3.05	3.83	2.49	3.08

CD(p≤ 0.05) Flour Combination (FC):0.001; Storage (S):0.001; FC × S :0.003

Amongst the overall means for flour, combination (F_0) recorded the highest mean moisture content of 3.67% whereas, flour combination (F_4) recorded the lowest moisture content of 2.49%. There was a significant increase in the moisture content of 3.00% from 0 day (S_0) to 3.17% at 50 days of storage (S_5) (Table 3). The increase in moisture content of *kulcha* might be due to its hygroscopic nature which have low moisture and hence absorb moisture from air. Similar results have been reported by Kumar and Barmanray (2007), Varshney *et al*. (2008), Eyidemir and Hayta (2009).

Crude fat (%)

Data represented in Table-4 revealed that flour combinations and storage periods showed a significant influence. The treatment F_4 S_0 (wheat: buckwheat flour %; 80:20; 0 days of storage) recorded the highest crude fat of 23.97% but a lowest of 22.10% was observed in case of treatment F_0S_5 (wheat:

buckwheat flour %; 100:0; 50 days of storage). The highest mean crude fat of 23.88 % was recorded in case of flour combination (F_4) where as, a lowest of 22.19% was reported in flour combination (F_0). Amongst the overall means for storage, 0 day (S_0) storage recorded the highest crude fat of 23.14% whileas, a product at 50 days of storage (S_5) recorded a lowest crude fat of 22.95 %. An increase in crude fat with increase in flour combination was observed because buck wheat flour is rich in fat content. A decrease in fat content with storage was also reported by Varshney *et al*. (2008) in defatted peanut and cereal biscuits, Singh *et al*. (2006) in pearl millet cake and by Nwabueze and Atuonwu, (2007) in African bread fruit seeds incorporated biscuits.

Table 4: Effect of flour combinations and storage periods on crude fat (%) of *kulcha*

Storage days	Flour combinations Wheat : buck wheat					Mean
	F_0 (100:0)	F_1 (95:5)	F_2 (90:10)	F_3 (85:15)	F_4 (80:20)	
0 (S_0)	22.28	22.73	23.16	23.56	23.97	**23.14**
10 (S_1)	22.25	22.70	22.13	23.53	23.94	**22.19**
20 (S_2)	22.22	22.69	23.10	23.49	23.91	**23.08**
30 (S_3)	22.19	22.65	23.06	23.45	23.88	**23.04**
40 (S_4)	22.15	22.61	23.02	23.41	23.84	**23.00**
50 (S_5)	22.10	22.56	22.97	23.36	23.79	**22.95**
Mean	22.19	22.65	22.90	23.46	23.88	23.02

CD(p≤ 0.05) Flour Combination (FC): 0.008; Storage (S): 0.008; FC × S: 0.019

Crude protein (%)

Flour combinations influenced significantly the crude protein (%) of *Kulcha* whereas, storage periods had a non-significant influence. The treatment F_4S_0 (wheat: buckwheat flour %; 80:20; 0 days of storage) recorded the highest crude protein of 9.41% but a lowest of 6.87 % was observed in case of treatment F_0S_5 (wheat: buckwheat flour %; 100:0; 50 days of storage). The crude protein increased significantly with increase in flour combination from 7.40 % in flour combination [F_0] to 8.69 % in flour combination [F_4] because buck wheat has abundant of protein content and is called as a complete protein food (Ozola *et al.* 2011).A decrease in the crude protein of 8.69 % from 0 day (S_0) to 7.37 % at 50 days of storage (S_5) was recorded (Table-5). However, protein content decreased from 8.69% to 7.37 % during 50 days of storage. The decrease in protein content during storage might be due to the hydrolysis of peptide bonds by the help of protease enzyme that cause splitting of protein molecules during storage (Ahmed *et al.* 2013).

Table 5: Effect of flour combinations and storage periods on crude protein (%) of *kulcha*

Storage days	Flour combinations Wheat: buckwheat					Mean
	F_0 (100:0)	F_1 (95:5)	F_2 (90:10)	F_2 (85:15)	F_2 (80:20)	
0 (S_0)	8.01	8.34	8.69	9.01	9.41	**8.69**
10 (S_1)	7.69	8.04	8.37	8.62	9.06	**8.35**
20 (S_2)	7.48	7.82	8.06	8.36	8.80	8.10
30 (S_3)	7.28	7.61	7.81	8.09	8.56	**7.97**
40 (S_4)	7.07	7.41	7.56	7.82	8.31	**7.63**
50 (S_5)	6.87	7.18	7.22	7.57	8.02	**7.37**
Mean	7.40	7.73	7.95	8.24	8.69	8.00

CD(p≤ 0.05) Flour Commination (FC): 0.008; Storage (S): NS; FC × S: 0.020.

Crude fibre (%)

A significant rise in crude fibre was observed with increase in flour combination because whole flour of buckwheat is rich in crude fibres. Amongst the overall means for flour combinations (F_4) recorded the maximum mean crude fibre of 6.66 per cent whereas, flour combination (F_0) recorded a minimum of 5.77 %. (Table 6). During a storage of 50 days crude fibres decreased from 6.29% (0 day of storage) to 6.09% (50 days of storage). The decrease in crude fibres might be due to the degradation of hemicelluloses and other structural polysaccharides during storage (Maneju *et al.* 2011). Besides, heat and moisture solubilizers degrade pectic substances leading to the decrease in the fibre content (Stojceska and Ainsworth, 2008).

Table 6: Effect of flour combinations and storage periods on crude fibre (%) of *kulcha*

Storage days	Flour combinations Wheat: buck wheat					Mean
	F_0 (100:0)	F_1 (95:5)	F_2 (90:10)	F_3 (85:15)	F_4 (80:20)	
0 (S_0)	5.87	6.02	6.31	6.51	6.75	**6.29**
10 (S_1)	5.84	5.99	6.28	6.48	6.72	**6.26**
20 (S_2)	5.80	5.96	6.25	6.45	6.69	**6.23**
30 (S_3)	5.75	5.92	6.21	6.41	6.65	**6.18**
40 (S_4)	5.70	5.88	6.17	6.37	6.61	**6.14**
50 (S_5)	5.66	5.83	6.12	6.32	6.56	**6.09**
Mean	5.77	5.93	6.22	6.42	6.66	6.20

CD(p≤ 0.05) Flour Combination (FC): 0.008; Storage (S): 0.008; FC × S: NS

Microbial quality of *Kulcha*

Baking destroys all the micro-organisms but contamination of *kulcha* by fungi normally results from unclean utensils and equipments. Therefore maintaining good manufacturing practices (GMP) minimize the contamination. This means that all spoilage problems by moulds occuring after baking (Omer *et al.* 2010). Data pertaining to assess the fungal growth (Table 7) a significant influence on method of preparation. The *kulcha* prepared without and with HACCP (H_0 and H_1) recorded a maximum and minimum fungal count of 2.216 and 1.661 log cfu/g. The treatment H_0F_0 (*kulcha* prepared without HACCP; wheat: buckwheat flour %; 100:0) at 50 days of storage (S_5) recorded a maximum fungal count of 3.920 log cfu/g. No fungal growth was however, observed at 0 days of storage (S_0), irrespective of technique of product development. Similarly, no fungal growth was noticed in the *kulcha* prepared without HACCP (H_0), flour combination F_2 (wheat: buckwheat flour %; 90:10); flour combination F_3 (wheat: buckwheat flour %; 85:15); flour combination F_4 (wheat: buckwheat flour %; 80:20) at 10 days of storage (S_1) and flour combination F_3; flour combination F_4 at 20 days of storage (S_2).

In kulcha prepared with HACCP (H_1) flour combination F_1, F_2, F_3, F_4 at 10 days of storage (S_1); flour combination F_2,F_3, F_4 at 20 days of storage (S_2) and flour combination F_3, F_4 at 30 days of storage (S_3). The maximum and minimum mean fungal count of 2.822 log cfu/g was observed in product developed without HACCP and flour combination F_0 and 1.022 log cfu/g in product developed with HACCP (H_1) and flour combination F_4. The fungal count decreased with increase in buck wheat flour concentration. Amongst the factor means for product developed without HACCP (H_0), *Kulcha* recorded the highest mean fungal count of 2.216 log cfu/g whereas, product developed with HACCP (H_1) recorded the lowest count of 1.661 log cfu/g. These results are in close proximity with those of Clarke and Arendt (2005), Brandt (2007), Omer *et al.* (2010) and Samapundo *et al.* (2010).

Table 7: Effect of flour combinations, product development techniques and storage periods on fungal count log (cfu/g) of *kulcha*

Flourcomb. → Storage days ↓	Development of kulcha without HACCP (H_0)					Mean
	F_0 (100:0)	F_1 (95:5)	F_2 (90:10)	F_3 (85:15)	F_4 (80:20)	
0 (S_0)	0.000	0.000	0.000	0.000	0.000	0.000
10 (S_1)	2.823	2.523	0.000	0.000	0.000	1.069
20 (S_2)	3.000	2.828	2.523	0.000	0.000	**1.670**
30 (S_3)	3.522	3.425	3.301	3.000	2.828	**3.215**
40 (S_4)	3.668	3.602	3.522	3.425	3.301	**3.504**
50 (S_5)	3.920	3.884	3.845	3.801	3.753	**3.841**
Mean	2.822	2.710	2.199	1.704	1.647	2.216
Storage days	**Development of kulcha with HACCP (H_1)**					**Mean**
0 (S_0)	0.000	0.000	0.000	0.000	0.000	**0.000**
10 (S_1)	2.523	0.000	0.000	0.000	0.000	**0.505**
20 (S_2)	2.823	2.523	0.000	0.000	0.000	**1.069**
30 (S_3)	3.000	2.828	2.523	0.000	0.000	**1.670**
40 (S_4)	3.522	3.425	3.301	3.000	2.828	**3.215**
50 (S_5)	3.668	3.602	3.522	3.425	3.301	**3.504**
Mean	2.589	2.063	1.558	1.071	1.022	1.661

CD(p≤0.05) Flour Combination (FC): 0.001; Storage (S): 0.001; FC×S: 0.001

HACCP ANALYSIS FOR KULCHA PLANT

Sl.No.	Process Step		Hazard	Control Measures	CCP	Critical Limits	Monitoring Procedure	Corrective Action	Responsible Personnel
1	Shortening	1.1	Foreign bodies in final product, Survival of microorganisms, Rancidity.	Approved Supplier and Compliance with specification	8	Compliance with Specification	Certificate of analysis with every delivery, Random challenge testing, Stock Rotation in Shortening	Reject out specification deliveries, Inform Q.A. and supplier	Q.A. Stores personnel production
2	Sugar	2.1	Foreign Bodies in final product ,Survival of microorganisms	Approved supplier and compliance with specification of sieve in line.	8	Compliance with specification	Certificate of analysis with every delivery, Random challenge testing	Reject out specification deliveries, Inform Q.A. and supplier	Q.A. production Stores
3	Flour Intake	3.1	Foreign bodies in final product	Approved supplier and compliance with specification sieve line; 4 and 6 mm mesh	1	Sieve integrity, sieve contact number and sieve damage	Certificate of analysis with every delivery. Daily check of integrity of sieve.	Rejection of specification deliveries, follow sieve procedure engineering.	Q.A. Stores personnel, Engineers.
		3.2	Infestation in silos.	Pest control contact and hygiene schedule.	---	Activity in traps, other evidences e.g. dropping of beetles.	Annual Cleaning and monthly inspection.	Pest control advice.	Pest controller and hygiene personnel.
		3.3	Survival of microorganisms.	Purchase from approved audited supplier.	8	Compliance with specification.	Certificate of analysis, Random challenge testing.	Reject out specification deliveries, Inform Q.A. and supplier.	Q.A. production Stores.
4	Sodium Bicarbonate (Baking Powder)	4.1	Foreign Matter in final product, Survival of microorganisms	Purchase from approved audited supplier	8	Compliance with specification	Certificate of conformity on each delivery	Rejection of specification deliveries, Inform Q.A. and suppliers	Q.A. Stores production.

(Cont.. Table)

5	Eggs	5.1	Foreign Matter in final product, Unsanitary practice and poor personal hygiene, Temperature control.	Approved supplier and compliance with specification	1	Compliance with Specification	Random challenge testing, Stock Rotation.	Rejection of specification deliveries, Inform Q.A. and suppliers	Q.A. Stores production.
6	Milk	6.1	Survival of microorganisms, Foreign matter	Routine Microbiological checks, Compliance with specification	8	Compliance with specifications	Certificate of analysis, Random challenge testing	Inform food safety board of contamination, stop use of suspect milk. Recall suspect procedure	Food safety production, Q.A. Stores personnel
7	Milk Powder	7.1	Foreign Matter in final product.	Purchase from approved audited supplier.	---	Compliance with specification	Certificate of analysis with every delivery, Random challenge testing	Reject out specification deliveries, Inform Q.A. and supplier	Q.A. production Stores
8	Poppy Seeds	8.1	Foreign matter, survival of microorganisms.	Purchase from approved audited supplier	---	Compliance with specification	Certificate of conformity on each delivery	Rejection of specification deliveries, Inform Q.A. and suppliers	Q.A. Stores production.

Conclusion

It can be concluded that incorporation of buckwheat flour up to 20% and introducing HACCP as product formulation technique in *Kulcha* not only improved the nutritive value but also improved the safety and storage stability of *Kulcha*. The buckwheat has also maintained the ingenuity of the product and has increased its market value. Thus, incorporation of buck wheat flour results in value addition of cereal based products.

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