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Quality analysis of composite flour and its effectiveness for *Chapatti* formulation

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Abstract
Almost 90% of the wheat produced in India is consumed in the form of *chapatti*. Wheat is a good major source of calorie, minerals, vitamins and photochemical like phenols, fair source of protein, amino acids and dietary fibre. However it is deficient in essential amino acids like lysine. Keeping in view these things in the present study composite flour was formulated containing wheat, chick pea, finger millet and barley in 70:10:10:10 respectively, to supplement wheat flour *chapatti*. The physico-chemical characteristics, nutritional quality and shelf life of the composite flour were investigated. The textural properties of composite flour dough and sensory qualities of composite flour *chapatti* were also analyzed. It was found that the ash content, insoluble fibre, energy, calcium and phenol content in composite flour were 2.08%, 11.55%, 354 Kcal/100g, 90.8mg/100g and 549.70 mg GAE/100g whereas 2.5%, 9.2%, 344 Kcal, 46.5 mg/100g and 379 mg GAE/100g respectively in wheat flour. The storage study of composite flour showed that the Peroxide value, free fatty acid content and total plate count of the composite flour was within the acceptable limit. On the basis of sensory evaluation using Nine Point Hedonic scale and score card method; formulated *chapatti* was found to be moderately acceptable by the panellists.

Keywords: composite flour, physico-chemical properties, proximate composition, *chapatti, sensory* evaluation, storage stability

1. Introduction

Wheat (*Triticum aestivum* L.) is a cereal belonging to the family Graminae. The annual world production of wheat exceeds that of any other grain, legume, or food crop. It is consumed worldwide after milling it into flour, primarily in the form of breads, and is a major source of nutrients (FAO, 2013) [11].

Unleavened flat breads-*chapattis* are made from whole wheat flour and have served as staple diet to the inhabitants of India, Pakistan, and parts of the Middle East (Nandini & Salimath, 2001) [20]. *Chapattis* are consumed fresh in households where it may represent 90% of the dietary energy intake (Rao, 1993) [12]. Almost 90% of the wheat produced in India is consumed in the form of chapatti. Only 10% of the wheat produced in India is consumed in making bread/biscuits/cake and such other products.

Wheat is a good source of calorie, minerals, vitamins and phytochemical like phenols, fair source of protein, amino acids and dietary fibre. However it is deficient in lysine.

Legumes have been known as ‘‘a poor man’s meat’’. They supply protein, complex carbohydrates, fibre and essential vitamins and minerals to the diet, which are low in fat and sodium and contain no cholesterol. In addition, legume proteins are rich in lysine and deficient in sulphur containing amino acids, whereas cereal proteins are deficient in lysine, but have adequate amounts of sulphur amino acids. Therefore, the combination of grain like wheat with legume proteins would provide better overall essential amino acid balance, helping to overcome the world protein calorie malnutrition problem. Chick pea, pigeon pea, mung bean, urad bean, lentil and field pea are the important pulses of significant dietary importance.

Use of composite flour (CF) based on wheat and other cereals including millets in bakery products is becoming popular because of the economic and nutritional advantages. Some millets like finger millet, pearl millet, barley, foxtail millet, barnyard millet etc. have impressive nutritional quality.

Composite flour is a mixture of flours, starches and other ingredients intended to replace wheat flour totally or partially in bakery and pastry products. Shittu *et al.* (2007) [29] also agreed with that as the composite flours used were either binary or ternary mixtures of flours from some other crops with or without wheat flour.

Therefore, the combination of wheat with pulse flours and millet flour as a potential composite flour may provide better overall essential amino acid balance, dietary fibre, antioxidants and high mineral content as compared to wheat flour, which may help to overcome the problem of Protein Energy Malnutrition and different degenerative diseases like CVD's, obesity, hypertension and different forms of cancer.

Keeping in view these facts the present study was carried out with the objective to formulate composite flour containing wheat, chick pea, finger millet and barley and to study its effectiveness and suitability for *chapatti* making.

2. Materials and Methods
2.1 Raw Materials
Different grains viz. wheat, chick pea, finger millet and barley were procured from Pantnagar market, Uttarakhand, India. All the grains were cleaned to remove the foreign particles, washed properly and dried in hot air oven at 60˚C temperature, separately. Dried grains were processed into flours using Atta master milling machine and sieved through 44 mesh size separately. Composite flour (CF) was prepared by mixing 70% wheat flour, 10% chick pea flour, 10% finger millet flour and 10% barley flour.

2.2 Physico-chemical properties of flours
Composite flour (CF) and wheat flour (WF) quality was assessed for different physico-chemical parameters viz. Water Absorption Capacity (Smith and Circle, 1972) [32], Optimum Water Uptake (Anderson *et al.*,1969) [1], Bulk Density (Narain *et al.*,1978) [21], Gluten content (AACC. 1969) [2], flour colour (Kulkarni *et al.*, 1987) [15] and Particle Size Index (Bedolla and Rooney**,** 1984) [9].

2.3 Nutritional and Chemical composition of flours
Nutritional quality of composite flour (CF) and wheat flour (WF) viz. moisture content, crude protein, total ash, crude fat, crude fibre and carbohydrate by difference; was analyzed as per standard methods (AOAC, 2000) [5]. Physiological energy value was calculated as per the method given by Mudambi *et al*., 1989 [17].

2.3.1 Total Phenol Content
Total phenolic content was determined by Folin–Ciocalteu's method **(**Singleton *et. al.*, 1999) [31] using spectrophotometric method. Different sample aliquots were taken in test tubes and their volume was made to 1.5 ml with distilled water. Then 0.5 ml of Folin–Ciocalteu reagent was added. After that 10 ml of 7.5% of Sodium Carbonate was added and incubated at 37°C for 60 minutes. Standard series were prepared using known concentration of Gallic acid (5-20µg). For blank 1.5 ml of distilled water was taken and treated same as sample. Absorbance of resulted blue color was read at 750 nm.

Total Phenol (mg GAE/100g) =

$$\frac{\text{Standard concentration}}{\text{Standard O.D.}} \times \frac{\text{Sapmle O.D.}}{\text{Aiquot taken}} \times \frac{\text{Volume made up}}{\text{Sample taken}} \times \frac{100}{1000} \times \text{Dilution factor}$$

2.3.2 Mineral Content
Calcium and iron content in composite flour (CF) and Wheat flour (WF) was estimated using atomic absorption spectrophotometer method as described by Raghuramulu *et al.* (2003) [27].

2.3.3 Total Dietary Fibre
Total dietary fibre content of composite flour (CF) and Wheat flour (WF) was estimated using method of Asp and Johansson (1981)**.** Powder sample was gelatinized and protein and starch were removed by enzymatic digestion. The residue was filtered, washed and quantitatively measured for insoluble dietary fibre. Soluble dietary fibre was estimated in the titration obtained after enzymatic digestion then it was precipitated and estimated gravimetrically.

2.4 Textural analysis of doughs
Composite flour (CF) and wheat flour (WF) dough were analyzed for textural properties viz; hardness, springiness, cohesiveness, chewiness and resiliency at room temperature using a texture analyzer (Stable Micro System, Model TA.XT2i/25 UK, using probe P/75 compression platen) attached to software (texture expert).Texture profile analysis was performed using three pieces of each dough sample (2×2×1.5 cm) which were placed on a platform in a fixture and compressed twice to 50% of their original height by compression probe (P/75).

2.5 Chapatti preparation and sensory evaluation
Doughs analyzed using texture analyzer (TA HD plus) were used for the formulation of "*chapatti"*, which were then evaluated for sensory characteristics using Nine Point Hedonic Scale (9- like extremely, 8- like very much, 7- like moderately, 6- like slightly, 5- neither like or dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much and 1- dislike extremely) and sensory score card method (Amerine *et al.*, 1965) [4] for taste, color and appearance, puffiness, flavour and overall acceptability. Sensory evaluation was done by a semi-trained panel consisting of 15 members from the Department of Foods and Nutrition, GBPUAT, Pantnagar.

2.6 Storage study of composite flour
The storage stability of composite flour (CF) was evaluated by the Total Plate Count method (APHA, 1992) [6]. Appropriate dilutions of the sample (1ml) were transferred aseptically to sterile petri plates in duplicate and mixed well with 10-15 ml of pre sterilized plate count agar at 45 ºC. After solidification plates were incubated at 37 ºC for 48 hours in bacteriological incubator.

Free fatty acid content and Peroxide value of composite flour (CF) was also determined using the standard method of AOAC, 2000 [5]. The composite flour was stored in a High Density Polyethylene bag at room temperature (20 to 35°C) for a period of 60 days. The samples were drawn at 0, 30th and 60th days interval and evaluated for the above parameters.

2.7 Statistical analysis
All the observations were taken in triplicate and subjected to analysis using 2 sample T- test at $p<0.01$ level of significance.

3. Results and Discussion
3.1 Physicochemical properties of flour
The functional properties of flours play important role in the manufacturing of different types of products. The composite flour and wheat flour were analyzed for their functional properties. Table 1 shows the various functional properties and colour values of flours. Water absorption capacity

represents the weight of water taken up per gram of flour (Molina *et al*., 1977) [16]. The Water absorption capacity (WAC) of flour has an important role in the food product preparation process, as it influences other functional and sensory properties. The water absorption capacity of composite flour (CF) was found to be 0.70 ml/ g whereas 0.60ml/g in case of wheat flour. Increase in the WAC of composite flour can be attributed to comparatively higher carbohydrate content in finger millet and barley flour than the wheat flour. Optimum water intake of composite flour (CF) was found to be 0.9ml/g whereas 0.7ml/g in case of wheat flour. Gluten content of composite four was found to be 0.56g/g where as in case of wheat flour 0.82g/g. Lower gluten content in composite flour is due to substitution of wheat flour with barley, finger millet and chick pea flour. Bulk density of composite flour was found to be 1.41 g/cm^3 whereas in case of wheat flour 1.36g/cm^3.The higher bulk density of composite flour (CF) may be due to the presence of more crude fibre in composite flour in accordance with the observation made by Singh *et al*. (1996) [30]. The bulk density is usually influenced by the structure of starch polymers and loose structure of the starch polymer may result in low bulk density (Plaami, 1997) [24]. Bulk density is generally affected by the particle size and the density of the flour and it is very important in determining the packaging requirement, material handling and application in wet processing in the food industry. The hue and value in case of composite flour (CF) was recorded as 10YR (8/3) respectively, whereas in case of wheat flour hue and value observed was 7.5YR (8/2) respectively. All the values were designated as yellow red on Munsell soil colour chart (1954). For the estimation of particle size index, the sieved amount of composite flour (CF) on different mesh sizes of 60, 72 and 85 were recorded as 94.5%, 2.68%, 0.68% and 1.92% on the last container respectively whereas 92.04%, 3.4%, 1.12% and 3.06% in case of wheat flour. Particle size index, a parameter inversely related to fineness of flour (Bedolla and Rooney, 1984) [9], also affects water absorption capacity (Khan *et al*., 1982) [14]. Significant p<0.01 difference was observed in all the physico-chemical properties of composite and wheat flour.

Table 1: Physicochemical characteristics of composite flour and wheat flour

Physicochemical parameters	Composite flour (Mean value±S.D.)	Wheat flour (Mean value±S.D.)
Water absorption capacity (ml/g)	0.70**±0.01	0.60**±0.7
Optimum water intake(ml/g)	0.90**±0.0	0.70**±0.0
Gluten content(g/g)	0.56**±0.003	0.82**±0.02
Bulk density(g/cm^3)	1.41**±0.01	1.36**±0.002
colour	10YR(8/3)±0.0	7.5YR(8/2)±0.0
Particle size index (%)		
on 60 mesh size sieve	94.5**±0.32	92.04**+1.0
on 72mesh size sieve	2.68**±0.16	3.4**±0.2
on 85 mesh size sieve	0.68**±0.08	1.12**±0.02
on last container	1.92**±0.11	3.06**±0.1

All values are average of triplicate observations ± standard deviation**** = P≤ 0.01 NS = Non significant
Composite flour- wheat flour: chick pea flour: finger millet flour: barley flour: 70:10:10:10

3.2 Nutritional and chemical composition
3.2.1 *Proximate composition*
The moisture content of composite flour (CF) was found to be 11.98% and 11.87% in wheat flour. These values meet the specification of not more than 15.5% moisture in flour blends, as given by Codex-Alimentarius, 2016. The crude protein content in composite flour (12.27%) was significantly high as compared to the protein content in wheat flour which was 11.56%. The higher protein content of 25.5 g/100g in chick pea flour, observed by Mohammed *et. al*, 2012 [19] may be the reason for higher protein content of composite flour. The fat content of composite flour (CF) was found to be 1.97 % whereas in case of wheat flour fat content was 1.65%. A Significant difference was found between total ash content of composite flour and wheat flour at p<0.01 level of significance. The total ash content of composite flour (CF) was found to be 2.08% whereas in case of wheat flour total ash content was 2.50%. In case of composite flour crude fibre content was found to be 2.27% and 1.73% in case of wheat flour, which was significant p<0.01. High crude fibre content in barley, finger millet and chick pea might have contributed to higher crude fibre content of composite flour (CF). In case of composite flour carbohydrate content was found to be 69.96% whereas 70.15% in wheat flour. Energy value of composite flour was calculated to be 346.67 Kcal where as in wheat flour it was found to be 341.69 Kcal (Table-2). Significant difference was found between energy content of composite flour and wheat flour at p<0.01 level of significance.

Table 2: Proximate composition of Composite flour and Wheat flour

Nutrient composition	Composite flour (Mean value±S.D.)	wheat flour (Mean value)
Moisture (%)	11.98**±0.0	11.87**±0.01
Crude protein (%)	12.27**±0.11	11.56**±0.05
Crude fat (%)	1.97**±0.03	1.65**±0.04
Total ash (%)	2.08**±0.01	2.50**±0.0
Crude fibre (%)	2.27**±0.04	1.73**±0.02
Carbohydrate (%)	69.96^{NS}±0.16	70.15^{NS}±0.09
Energy (kcal/100g)	346.67**±0.11	341.69**±0.34

All values are average of triplicate observations ± standard deviation
** = P≤ 0.01 NS = Non significant
Composite flour- wheat flour: chick pea flour: finger millet flour: barley flour: 70:10:10:10

3.2.2 Mineral content: The amount of calcium and iron were found to be 90.8 and 10.01 mg/100g respectively in composite flour whereas 46.5, 10.6 mg/100g in case of wheat flour (Table3). A high calcium content of 344 mg/100g in finger millet, studied by Gopalan *et. al,* 1989 [12] may have contributed to high calcium content in composite flour (CF).

3.2.3 Total Phenol content*:* In case of composite flour (CF) phenol content was analyzed to be 549.70 mgGAE/100g whereas phenol content was reported as 379 mgGAE/100g by Gunashree *et al*. (2014) [13] in wheat flour. Significant difference was found between the phenol content of both the flours at $p<0.01$ level of significance. High phenol content in the chick pea (801mgGAE/100g) as reported by Rani and Khabiruddin (2015) [25] may be one of the reasons for comparatively high phenol content of composite flour.

Table 3: Minerals, Total phenol and Dietary fibre content in composite flour and Wheat flour:

Minerals	**Composite flour**	**Wheat flour**
Calcium(mg/100g)	$90.8^{**}\pm0.5$	$46.5^{**}\pm0.6$
Iron(mg/100g)	$10.01^{**}\pm0.01$	$10.6^{**}\pm0.11$
Total phenol content		
Total phenol content(mg GAE/100g)	Composite flour	Wheat flour
	$549.70^{**}\pm4.32$	$379.0^{**}\pm2.29$
Dietary fibre		
Soluble fibre (%)	$2.27^{**}\pm0.04$	$2.82^{**}\pm0.08$
Insoluble fibre (%)	$11.55^{**}\pm0.10$	$9.20^{**}\pm0.02$
Total Dietary Fibre (TDF)	$13.82^{**}\pm0.14$	$12.02^{**}\pm0.06$

All values are average of triplicate observations ± standard deviation**** = P≤ 0.01**

Composite flour- wheat flour: chick pea flour: finger millet flour: barley flour:: 70:10:10:10

3.2.4 Dietary fibre content

The amount of soluble and insoluble dietary fibre in case of composite flour was found to be 2.27% and 11.55% respectively whereas in case of wheat flour it was analysed to be 2.82% and 9.2% respectively (Table 3). Significant difference was found between both, soluble and insoluble dietary fibre content of composite flour (CF) and wheat flour at $p<0.01$ level of significance.

3.3 Textural properties of composite and wheat flour dough

Texture profile analysis (TPA) method is widely used for texture evaluation of food products. Human eating action normally consists of several bites. In order to better describe the eating actions of humans, the TPA method was described by Peleg (1976) [23]. The TPA test performs two bites; every bite includes compression and decompression cycles. Freshly prepared doughs were evaluated for their textural properties using texture analyzer. A round disk probe of 75mm diameter was used to exert the strain of 75% in the middle of the each dough sample. The dough samples were tested in the Strain mode for 5 seconds, with the trigger force of 50g. The probe test speed was 5mm/sec.

Table 4 shows the data on the textural properties of composite and wheat flour dough. Significant changes were observed in the textural qualities of composite flour. Hardness can be defined as “peak force required for the compression of doughs to maximum extend”. Data on textural qualities expressed in Table 4 showed the hardness (g/cm^2) of the dough of composite flour and wheat flour which was found to be 45676.89 and 19825.35, respectively. Significant difference was found between the hardness of composite and wheat flour dough at $p<0.01$ level of significance.

Springiness refers to the height that the sample recovers during the time that elapses between the end of first bite and the start of second bite. In general, it is associated to the freshness in a food product. The springiness found in composite flour dough was 0.255 cm/mm and in wheat flour dough was 0.387 cm/mm. Significant difference was found between the springiness of composite and wheat flour dough $p<0.01$ level of significance.

Resiliency is the ratio of area during withdrawal of the first compression to the area of the first compression. The average value of resiliency was found to be 0.06 and 0.07 in composite and wheat flour dough respectively. Significant difference was found between the resilience of composite and wheat flour dough $p<0.01$ level of significance.

Cohesiveness is a measure of the ratio of the area of work during the second compression to the area of work during the first compression. Cohesiveness of composite flour dough was 0.202 and 0.358 in wheat flour dough. Significant difference was found between the cohesiveness of composite and wheat flour dough at $p<0.01$ level of significance.

Chewiness is (=hardness ×cohesiveness ×springiness N) a parameter associated with ease/ difficulty in chewing the food and forming a bolus before swallowing. The chewiness of composite flour and wheat flour dough was found to be 2349.282 and 2742.361 respectively.

The values for adhesiveness and gumminess were found to be 1549.93 g.sec and 2349.282 g/cm^2 in case of composite flour dough and 1220.15 g.sec, 2242.361 g/cm^2, respectively in case of wheat flour dough. Significant difference was found between the adhesiveness and gumminess of composite and wheat flour dough at $p<0.01$ and $p<0.01$ level of significance respectively.

Low gluten content (0.56g/g), high insoluble dietary fibre content (11.55%) and high Total Dietary Fibre content (13.82%) of composite flour as compared to 0.82g/g gluten content, 9.6% insoluble dietary fibre and Total Dietary Fibre content (12.02%) in wheat flour, may be one of the reasons for differences among the textural quality parameters.

Table 4: Textural qualities of composite flour and wheat flour dough:

Parameters	Composite flour (Mean value±S.D.)	Wheat flour (Mean value±S.D.)
Hardness (g/cm^2)	45676.89**± 0.14	19825.35**±0.02
Adhesiveness (g.sec)	1549.93**±0.04	1220.15**±0.02
Springiness (cm/mm)	0.25**±0.00	0.38**±0.0
Cohesiveness (ratio)	0.20**±0.00	0.35**±0.0
Gumminess (g/cm^2)	2349.28*±0.00	2242.36*±0.00
Chewiness (g/cm)	3349.28**±0.00	2742.36**±0.07
Resiliency (ratio)	0.06**±0.00	0.07**±0.0

All values are average of triplicate observations ± standard deviation ** = P≤ 0.01

Composite flour- wheat flour: chick pea flour: finger millet flour: barley flour: 70:10:10:10

3.4 Sensory quality evaluation of Composite flour (CF) and wheat flour *chapatti*

For the sensory quality evaluation, *chapattis* were prepared using composite flour (CF) and wheat flour (WF) separately. Wheat flour (WF) *chapatti* was considered as control.

Composite flour (CF) and Wheat flour (WF) *chapatti* was evaluated using Score-Card method for taste, color and appearance, puffiness, flavour and overall acceptability. The results showed that composite flour *chapatti* scored average values of 7.06, 7.26, 7.26,7.13 and 7.0, whereas wheat flour *chapatti* scored 8.55, 8.66, 8.46, 7.73 and 8.53 out of 10 for taste, colour and appearance, puffiness, flavour and overall acceptability respectively. Significant difference was observed among all the sensory parameters for both the *chapattis* at p<0.01 level of significance (Table 5).

Data on evaluation of composite flour (CF) *chapatti* and Wheat flour (WF) *chapatti* for preference using Nine Point Hedonic Scale showed that composite flour chapatti was liked very much by 13.33%, liked moderately by 46.66%, liked slightly by 33.33% and neither liked nor disliked by 6.66% panel members, whereas wheat flour chapatti was liked extremely by 13.33%, liked very much by 40%, liked moderately by 40% and liked slightly by 6.66% (Table 6).

Based on above observations composite flour *chapatti* was found to be moderately acceptable as compared to control by the panellists.

Sensory evaluation of prepared chapattis

Table 5: Mean sensory scores for composite flour and wheat flour *chapatti*

Parameters	Composite flour chapatti	Wheat flour chapatti
Taste	7.00**±0.17	8.50**±0.16
Colour and Appearance	7.21**±0.18	8.63**±0.13
Puffiness	7.24**±0.15	8.44**±0.15
Flavour	7.13**±0.15	7.74**±0.14
Overall acceptability	7.00**±0.14	8.54**±0.14

All values are average of 15 observations ± standard deviation, ** = P≤ 0.01

Table 6: Hedonic rating for composite flour and wheat flour chapattis:

Parameters	Composite flour (in %)	Wheat flour (in %)
Liked extreamly	-	13.33
Liked very much	13.33	40
Liked moderately	46.66	40
Liked slightly	33.33	6.66
Neither liked nor disliked	6.66	-

Composite flour- wheat flour: chick pea flour: finger millet flour: barley flour: 70:10:10:10

3.5 Storage stability of composite flour (CF): Storage stability of composite flour (CF) was evaluated on the basis of peroxide value; free fatty acid and total plate count. Data on storage stability are presented in Table 7.

3.5.1 Peroxide value (POV): The peroxide value in composite flour (CF) was found to be 0.791, 1.044 and 1.492 mgEq/kg at 0, 30th and 60th day respectively, whereas 0.77 mgEq/kg in case of wheat flour on 0 day as per Shazadi *et al*. (2005). Similar results were reported by Shazadi *et al.*(2005) which showed 0.53, 0.74 and 0.99 mgEq/kg POV on 0, 30th and 60th day respectively, in the composite flour (CF) containing wheat flour, lentil, chick pea and guar gum. An increase in peroxide value (POV) during 60 days storage was due to development of rancidity. Higher temperature of the storage room, heat and light are the key factors that further accelerate the reactions promoting increase in acidity.

3.5.2 Free fatty acid: The FFA content was also studied on 0, 30th and 60th day of the storage. The FFA in composite flour (CF) was found to be 0.334%, 0.440% and 0.546% on 0,30th and 60th day respectively (Table 7), whereas 0.23% on 0 day was reported in commercial wheat flour by Shazadi *et al*. (2005). Similar results were reported by Shazadi *et al*. (2005) which showed 0.19%, 0.25% and 0.31% FFA on 0, 30th and 60th day respectively in the composite flour, containing wheat flour, lentil, chick pea and guar gum.

Table 7: Effect of storage on Peroxide value, Free Fatty acid content and Total Plate Count of Composite flour (CF):

Storage period (Days)	Mean POV of composite flour (mgEq/kg)
0	0.791±0.00
30	1.044±0.00
60	1.492±0.09
Free Fatty acid content	
Storage period (Days)	Mean FFA of composite flour (%)
0	0.33±0.00
30	0.440±0.05
60	0.546±0.0
Total Plate Count	
0	*ND
30	2.2 x 10 ^{2}
60	5.5 X 10 ^{2}

All values are average of triplicate observations ± standard deviation
*ND- Not Detectable

3.5.3 Total Plate Count (TPC): Composite flour was studied for microbial load. The data presented in Table 7 reveals that bacteria were not detected initially before storage. However, the bacterial count increased significantly upon storage for two months. The composite flour had bacterial count of 2.2 x 10 ^{2} cfu /g at one month storage. TPC increased up to5.5X10^2 cfu/g after two months of storage, whereas Total plate count of whole wheat flour was reported to be 0.679 cfu/g by Victor *et al*. 2013 [33].

4. Conclusion

Plain wheat flour is used for *chapatti* preparation universally. Keeping in view the nutrient contribution; especially protein and amino acid, dietary fiber content, Total Phenol Content, calcium content; chickpea, finger millet and barley can be effectively used as supplement for improving the nutritive value of wheat flour.

Therefore from the present study it might be concluded that composite flour (70:10:10:10 :: wheat flour, chick pea flour, finger millet flour and barley flour respectively) may be used as a better substitute for wheat flour alone for *chapatti* making without affecting physico-chemical, sensory and textural properties of *chapatti* adversely as composite flour *chapatti* also contains good amount of minerals, Total Dietary fiber, energy content, protein, Total Phenol Content and calcium as compared to only wheat flour *chapatti*, which may improve the health status and prevent the risk of certain degenerative diseases on regular consumption.

5. References

1. Anderson RA, Conway HF, Pfeifer VF, Griffin EL. Roll and extrusion-cooking of grain sorghum grits, Cereal Science Today. 1969; 14:372.
2. AACC. Approved Methods of American Association of Cereal Chemists. Vol. I and II American Association of Cereal Chemists. Inc. Minnesota, USA, 1969.
3. Abidi I, Mansouri S, Radhouane L, Ksouri R, El-Felah M, Bouzid S. Phenolic, flavavonoid and tannin contents of Tunisian barley landraces, International Journal of Agriculture Innovation and Research. 2015; 3(5):1417-1423.
4. Amerine MA, Pangborn RM, Roseller EB. Principles of sensory evaluation of foods, Academic Press, New York, 1965, 265.
5. AOAC. Official Methods of Analysis, Association of Official Analytical Chemists, 16th ed. Washington DC, 2000.
6. APHA. Culture methods for enumeration of microorganisms. In: Speak ML (ed) Compendium of methods for the microbiological examination of foods, 16th ed., American Public Health Association, Washington, 1992, 734.
7. Asp NG, Johansson CG. Techniques for measuring dietary fibre: principle aims of method and comparison of results obtained by different techniques. In: James, W.P.T. and Theander, O. eds. The analysis of dietary fibre in food, New York, Basel, Marcel Dekker. Inc. 1989, 173-190.
8. Baik BK, Ullrich SE. Barley for food: Characteristics, improvement, and renewed interest, J Cereal Science 2008; 48(2):233-242.
9. Bedolla S, Rooney LW. Characteristics of U.S. and Mexican instant maize flours for tortilla and snack preparation, Cereal Foods World. 1984; 29(11):732-735.
10. Codex-Alimentarius. Standard for Wheat Flour (adopted in 1985. Revision: 1995. Amendment : 2016). Codex Alimentarius - International Food Standards, WHO-FAO, Codex Stan, 1995, 152-1985.
11. FAO. FAO, Statistical year book. Rome: Author, 2013. http://www.fao.org/docrep/018/i3107e/i3107e03.pdf
12. Gopalan C, Rama sastri BV, Balasubramanian SC, Narasinga Rao BS, Deosthale YG, *et al.* Nutritive value of Indian Foods, Hyderabad, India, National Institute of Nutrition, ICMR, 1989, 47.
13. Gunashree BS, Selva R, Kumar RS, Roobini R, Venkateswaran G. Nutrients and antinutrients of ragi and wheat as influenced by traditional processes, International Journal of Current Microbiology and Applied Sciences. 2014; 3(7):720-736.
14. Khan MN, Denosiers MC, Rooney LW, Morgan RG, Sweat RE. Corn tortilla: Evaluation of corn cooking processes, Cereal Chemistry. 1982; 59(9):274-284.
15. Kulkarni DN, Betukar CM, Naheed KD, Rathi SS, Ingle OM. Grain quality studies in sorghum. College of Agriculture and Technology. Marathwada Agriculture University, Parbhani, India, 1987, 13-18.
16. Molina MR, Letona M, Bressani R. Drum drying for the improved production of instant tortilla flour, Journal of Food Science. 1977; 42(6):1432-1434.
17. Mudambi RS, Rao MS. Food Science, Chennai. New Age International (P) Publishers Ltd, 1989.
18. Munsell Soil Colour Charts. Munsell Colour Co. Inc., Baltimore 2, Maryland, USA, 1954.
19. Mohammed I, Ahmed AR, Senge B. Dough rheology and bread quality of wheat–chickpea flour blends, Industrial Crops and Products. 2012; 36(1):196–202.
20. Nandini CD, Salimath PV. Carbohydrate composition of wheat, wheat bran, sorghum and bajra with good chapati/roti (Indian flat bread) making quality, Food Chemistry. 2001; 73(2):197203.
21. Narain M, Siripurapeu SCB, Jha M, Devidi VK. Physicochemical properties of rice bran, Journal of Food Science and Technology. 1978; 15:18-19.
22. Nurul-Islam MD, Johansen HB. Physical chemical tests—A basis for selecting the size of wheat flour, Journal of Food Science and Technology, 1987; 24(3):136-138.
23. Peleg M. Texture profile analysis parameters obtained by an Instron universal testing machine, Journal of Food Science 1976; 41(3):721-722.
24. Plaami SP. Content of dietary fibre in foods and its physiological effects, Food Reviews International. 1997; 13(1):27-76.
25. Rani S, Khabiruddin M. Phytochemical Properties of Processed Chickpea Varieties of Haryana (India), Oriental Journal of Chemistry. 2015; 32(5):2803-2811.
26. Rao HP. Chapatti and related product. In R. Macrae, R. K. Robinson, & M. J. Sadler (Eds.), Encyclopedia of food science, food technology and nutrition. London: Academic Press, 1993; 2:795-801.
27. Raghuramulu N, Nair KM, Kalyanasundaram S. A Manual of Laboratory Techniques, National Institute of Nutrition, ICMR, Hyderabad, 2003.
28. Shahzadi N, Butt M, Rehman S, Sharif K. Chemical Characteristics of Various Composite Flours, International Journal of Agriculture & Biology. 2005; 7(1):105-108.
29. Shittu T, Raji AO, Sanni LO. Bread from composite cassava-wheat flour: I. Effect of baking time and temperature on some physical properties of bread loaf, Food Research International. 2007; 40(2):280-290.
30. Singh R, Singh G, Chauhan GS. Effect of incorporation of defatted soy flour on the quality of biscuits, Journal of Food Science and Technology. 1996; 33(4):355-357.
31. Singleton VL, Orthofer R, Lamuela-Raventos RM. Analysis of total phenols and other oxidation substrates

and antioxidants by means of Folin–Ciocalteu reagent, Methods in Enzymology. 1999; 299:152-178.
32. Smith AK, Circle SJ. Soyabean: Chemistry and Technology. Westport. Connecticut. 1972; 1:455-456.
33. Victor N, Bekele MS, Ntseliseng M, Makotoko M, Peter C, Asita AO. Microbial and Physicochemical characterization of maize and wheat flour from a milling company, International Journal of Food Safety, 2013; 15:11-19.