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# Studies on Replacement o f Water by Butter Milk to prepare Chapatti

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**ABSTRACT**

The investigation was undertaken to explore the possibility of utilization of buttermilk in chapatti making. Water was substituted in dough during chapattis making with buttermilk. Buttermilk was incorporated in chapattis dough at levels of 0 to 100 percent. The effect of water substitution was studied on dough handling and quality characteristics of chapattis. The dough handling was improved with augmented level of buttermilk. The augmented incorporation of buttermilk enhanced protein, fat and ash contents in the chapattis so prepared and therefore, improved their nutritional value. The effect of various levels of buttermilk on sensory attributes of appearance, color, flavor, mouth feel and over all acceptability of chapattis was found to be non-significant except for texture which was found to improve with increased level of buttermilk inclusion.

**Index Terms** - Buttermilk, Chapatti, Dough handling, Sensory characteristics

## I. INTRODUCTION

Butter milk and separated milk are obtained during the manufacture of butter and cream respectively. Buttermilk contains almost all other milk solids except fat, and is produced while butter and ghee are manufactured. Buttermilk has been used in the preparation of Ice-cream , bakery related products, yoghurt, dahi and beverages (**Chopra and Gandhi, 1989**). Buttermilk is a good source of proteins, carbohydrates, minerals, vitamins A- tocopherol and cholesterol **(Tylkin et al., 1975**). Production of buttermilk in India is estimated as 275.0 million kg per annum containing more than 25.0 million kg milk solids. An increased trend in the use of skim milk, buttermilk and whey in western countries for enriching milk products and as a basis for manufacturing other food products has been observed. Due to urbanization and advancement in technology, the food habits of people are changing. The trend is more towards the convenience foods. Therefore, the utilization of buttermilk in chapatti making will improve the nutritive value of chapatti at a cheaper rate. In spite of the new technologies having being involved full utilization. Different types of bread are made widely throughout the middle east and the Indian subcontinent (**Hui, 1992**). So substitution of chhana and paneer whey and buttermilk in chapatti will not only enhance the nutritive value but will solve the problem of waste disposal and also help in providing precious nutrients to the health conscious people. The work on the above is very scanty. Therefore, the present investigation to replace water with buttermilk in chapatti making was undertaken to utilize buttermilk.

## II. MATERIAL AND METHODS

**Materials-** whole wheat flour and buttermilk were collected from the local market of Jhansi.

**Blend formation-**water was replaced in the chapattis with buttermilk levels of 0, 20, 40, 60, 80, 100 percent.

**Steps of Chapatti making** –

- Preparation of dough- chapatti dough was prepared by mixing 100 gm of flour with the predetermined amount of water for 3 minute. It was allowed to rest for 15 minute.
- Rolling the dough- The dough was divided into four equal proportions. It was rounded in to a ball and placed in the centre of a specially designed platform. The dough was rolled to uniform thickness with a wooden rolling pin, to a circle 15 cm in diameter.
- Baking of chapatti- the chapatti was baked by traditional method on cast iron skillet (tawa)for 60 seconds giving first and second turning after 15 to 30 seconds, respectively, allowing each side to bake for equal time.
- Chapatti Storage- four chapattis were packed in a polyethylene bag and heat sealed. All

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

samples were stored at 22 C temperature and 55 percent relatively humidity.

**Physico- chemical characteristics of chapattis-** The protein content of flour was determined by Kjeldahl method **AOAC (1984)**, using a nitrogen to protein conversion factor of 5.71 for wheat. Moisture, fat, ash and crude fibre in the sample were estimated according to **AACC (1990)** methods**.** Phosphorus and iron were determined by colorimetric method as described by **AACC (1990),** while calcium was determined by **AACC (1990)** method, after precipitating Gluten content of plain and blended flour was determined according to the methods of **AACC (1990**). Pliability of chapattis was determined as per the method **of Verkateswara Rao et al.,(1986**) using a pliability tester. Water Hydration capacity was determined as per the method of **Martin et al., (1991) .**

**Sensory characteristics-** The Organoleptic characteristics of chapattis such as appearance, texture, mouth feel and over all acceptability were evaluated by an untrained panel of ten judges on a nine-point hedonic scale. Hedonic ranges from like extremely (9) to dislike extremely (1) for each organoleptic characteristic as suggested by **Ranganna (2003)**.

**Storage studies** –Chapattis were stored at room temperature (30-45C) and under refrigeration (2-5C) conditions. These were judged at regular intervals for shelf life of products.

**Statistical analysis-** The data were statistically analyzed a per the analysis of variance technique using two-way analysis without interaction (snedecor and Cochran, 1968).

## III. RESULT AND DISCUSSION

The present investigation was envisaged to utilize the milk byproducts namely buttermilk in chapatti. The samples of buttermilk were analyzed for chemical composition i.e., for the estimation of ash, fat, protein, total solids and sugars. Water was substituted in the chapattis with buttermilk level of 20, 40, 60, 80 and 100 percent. Effect of buttermilk incorporation on dough handling, physicochemical characteristics (moisture, puffing and hydration capacity) and sensory score (appearance, texture, mouth feel, and overall acceptability) of buttermilk incorporated chapattis was studied.

**Chemical Composition of Raw Material** –The chemical composition of buttermilk and whole wheat flour (Atta) is presented in Table 1. Buttermilk contained 10 percent total solids. The protein, fat and ash content of buttermilk were 3.98, 0.67 and 0.32 percent, respectively. The values are similar to those as reported by **Nutting et al., (1970).** The gluten content was 7.39 percent in whole wheat flour. The whole wheat flour containing 10.21 percent protein and 1.44 percent ash.

**Table 1 Physic- chemical composition of buttermilk and whole wheat f**lour

| Attribute (%) | Buttermilk | Whole Wheat flour |
|---|---|---|
| Moisture | 90 | 12.09 |
| Total solids | 10 | 87.91 |
| Protein | 3.98 | 10.21 |
| Fat | 0.67 | 1.19 |
| Wet Gluten | ---- | 22.23 |
| Dry Gluten | ---- | 7.39 |
| Carbohydrate (by difference) | 5.03 | 75.07 |
| Ash | 0.32 | 1.44 |
| Minerals | Mg/100gm | |
| Calcium | 406.81 | |
| Fe | 3.42 | |
| Potassium | 265.82 | |

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

| | | |
|---|---|---|
| Mg | 67.31 | |
| Phosphorous | 382.11 | |
| Sodium | 0.12 | |

The minerals content varied appreciably in buttermilk. Calcium content of buttermilk was 406.81 mg/100g. Iron content of buttermilk is 3.42. Magnesium, phosphorous and sodium were also found in buttermilk 67.31, 382.11 and 0.12 mg/100g, respectively.

**Chapatti making** – Effect of replacement of water with buttermilk on dough making /handling and physic-chemical properties of chapatti such as moisture, puffing, hydration capacity, pliability and overall acceptability are presented in Table 2

**Dough characteristics and handling**-The replacement of water with buttermilk from 0 to 100 percent, proportionately improved the smoothness and decreased the stickiness of dough . Control sample of dough was slightly sticky during handling i.e. for ball and chapatti making . Incorporation of buttermilk at increasing levels improved its handling by making it smooth and pliable. Moreover, the dough was devoid of stickiness during mixing, ball making and sheeting. This was because of incorporation of casein through buttermilk that eliminated the problem of stickiness (**Buchanan, 1979**).

**Table -2 Effect of buttermilk incorporation on dough handling and chapatti characteristics**

| Replacement (%) | Mixing | Ball making and sheeting | Increase in size of brown spots |
|---|---|---|---|
| 0 | Slighty stickly | fair | normal |
| 20 | smooth, good | good | fair/slight |
| 40 | smooth, good | good | fair to moderate |
| 60 | Smooth and pliable, good | good | moderate to high |
| 80 | Smooth and pliable, very good | very good | High |
| 100 | smooth and highly pliable, excellent | Excellent | High |

Improvement in dough characteristics on addition of milk solids was also observed by **Milosz and kowalczuk (1989)** . This was due to additional moisture held by protein of buttermilk .

**Earlier Bilgin et al.,(2006)** observed an improvement in dough properties with the replacement of 50 and 100 percent water with whey and buttermilk. The improvement was greater with 100 percent buttermilk. Puffing of chapattis during baking was also improved with the incorporation of buttermilk. The puffing improved proportionately with increase in the amount of buttermilk . However increasing level of water replacement with buttermilk enhanced number and size of brown spots. This might be due to enhanced maillared reaction during baking with increased protein content in dough . To explore the possibility of exploring WPC as a functional ingredient in Indian traditional product south Indian parotta investigation were made by **Inidrani et al., (2007)** to study the effect of replacement of wheat flour with 5, 10 and 15 percent WPC on the dough characteristics of wheat flour, quality of parotta , and microstructure of baked parotta. The quality characteristics of parotta showed that the spread ratio decreased and shear force values increased significantly above 5 percent level. Control parotta and parotta with 5 percent WPC

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

were soft, possessed thin and transparent layers where as parotta beyond 5 percent WPC had thick, fused and opaque layers.

**Proximate component of chapattis -**The proximate components of chapattis changed with the incorporation of buttermilk as shown in Table - 3. The fat content increased from 0.56 to 1.33 percent by incorporation of buttermilk and protein from 9.61 to 11.23 percent . Ash content was also enhanced from 1.31 to 1.86 percent. The fat content exhibited a high variation consequent upon incorporation of buttermilk with the CV value being 32.06 %. Similar enhancement was observed in protein and ash content of chapattis. The overall mean values as a result of replacements were observed to be 0.86, 9.79 and 1.61 percent for fat, protein and ash contents respectively with very low values for coefficient of variation.

**Moisture content of chapattis -**Effect of water replacement with buttermilk on moisture content of fresh chapattis and changes during storage is presented in Table -4 . Replacement of water with higher percentages of buttermilk added during the dough mixing process though improved the moisture content of chapattis, the differences were not found to be statistically significant ($P<0.01$) . The moisture content of fresh chapattis ranged from 38.06 to 38.46 percent on freshly prepared chapattis, with an increase in the replacement from 0 to 100 percent by buttermilk .

**Table -3 Effect of water replacement with buttermilk on proximate components of chapattis**.

| Replacement (%) | Fat (%) | Protein(%) | Ash(%) | Moisture (%) |
|---|---|---|---|---|
| 0 | 0.56 | 9.61 | 1.31 | 38.06 |
| 20 | 0.67 | 10 | 1.42 | 38.21 |
| 40 | 0.86 | 10.32 | 1.51 | 38.4 |
| 60 | 1.05 | 10.64 | 1.65 | 38.4 |
| 80 | 1.21 | 10.92 | 1.75 | 38.42 |
| 100 | 1.33 | 11.23 | 1.86 | 38.46 |
| Mean | 0.946 | 10.45 | 1.58 | 38.26 |
| CV | 32.06 | 5.72 | 12.97 | 0.404 |

**Table -4 Effect of water replacement with buttermilk on moisture content (%) of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 38.06 | 36.4 | 36.24 | 35.15 | 36.46 | 3.04 |
| 20 | 38.21 | 36.42 | 36.35 | 35.3 | 36.57 | 3.3 |
| 40 | 38.4 | 36.52 | 36.36 | 35.51 | 36.69 | 3.31 |
| 60 | 38.4 | 36.59 | 36.47 | 35.57 | 36.75 | 3.21 |
| 80 | 38.42 | 36.62 | 36.54 | 35.69 | 36.82 | 3.24 |
| 100 | 38.46 | 36.71 | 36.61 | 35.89 | 36.92 | 3.01 |
| Mean | 38.26 | 36.54 | 36.42 | 35.52 | | |
| CV | 0.404 | 0.323 | 0.378 | 0.744 | | |

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

Chapattis were stored thereafter in polythene bags which ultimately showed a significant (P<0.01) loss in moisture content on storage, being minimum in samples containing 100 percent buttermilk Table -4 . **Eaelier Rao et al., (1986)** observed negligible moisture loss in chapattis stored either in a polyethylene pouch or plastic containers for three days, whereas, those wrapped in waxed paper showed a considerable loss. it was also observed that drop in moisture content was significant during storage from 0 to 24 hours, and thereafter a gradual decline was witnessed in case of buttermilk replacements . The estimates of co-efficient of variation percent values indicated that variation in moisture content was higher consequent upon storage than substitution by milk byproducts (Table 6). The findings are in accordance **with Kaur and Bajwa (2000)** who observed that the storage caused a significant (P<0.01) drop in the moisture content of chapattis with and without liquid buttermilk which was further followed conventional and microwave reheating.

**Pliability of chapattis** –Pliability of chapattis improved significantly (P<0.01) with the inclusion of buttermilk in the dough (Table 5). It improved from 4.00 cm to 4.20 cm on conclusion of 100 percent buttermilk possibly due to additional protein storage of chapattis also had a significant (P<0.01) effect on pliability. Control chapattis had a pliability of 1.30 after 72 hours of storage. Pliability of chapattis deceased significantly after 24, 48 and 72hours storage, in all the samples. After 72 hours it decreased from 4.00 to 1.30 cm in control and from 4.20 to 2.98 in sample containing 100 percent buttermilk.

This implied that decline in moisture content was more than twice in control compared to the buttermilk incorporation chapattis. It was also evident from the results that decline in pliability was steep from 24 to 48 hours of storage buttermilk replacement . storage period caused high variability in pliability of chapattis reaching up to 53.4 percent in the control sample causing a significant (P<0.01 ) decline. Similar results were observed in whey incorporated samples as evident from the CV value.

**Earlier, Rao et al., (1986)** also observed a decrease in pliability value of chapatti during three days of storage in waxed paper. Improvement to pliability value of chapattis containing milk byproduct may be attributed due to the presence of phospholipids in buttermilk and soluble proteins of whey causing more retention of moisture during storage. An investigation was undertaken to study the effect of refreshening procedures on the quality characteristics of stored chapattis prepared with and without liquid buttermilk **by Kaur and Bajwa (2000).** They observed that pliability of chapattis was adversely affected after storage. However it improved significantly (P<0.01) following refreshening.

**Table -5 Effect of water replacement with buttermilk on pliability (cm) of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 4 | 3.36 | 2.14 | 1.3 | 2.27 | 54.4 |
| 20 | 4.01 | 3.6 | 2.4 | 1.97 | 2.99 | 32.25 |
| 40 | 4.1 | 3.88 | 2.58 | 2.5 | 3.27 | 25.76 |
| 60 | 4.13 | 3.94 | 2.68 | 2.6 | 3.34 | 24.32 |
| 80 | 4.16 | 3.97 | 2.75 | 2.68 | 3.39 | 23.03 |
| 100 | 4.2 | 4.06 | 2.98 | 2.98 | 3.5 | 18.95 |
| Mean | 4.1 | 3.8 | 2.59 | 2.33 | | |
| CV | 1.88 | 7.01 | 11.19 | 26 | | |

**Hydration capacity** –Hydration capacity of chapattis differed significantly with levels of buttermilk as also with the storage period (Table 6 ). Hydration capacity improved with the incorporation of milk byproducts, whereas it decreased significantly (P<0.01) with storage. Hydration capacity of control was 2.42 and 2.41 which increased to 2.46 and 2.44 with incorporation of 100 percent buttermilk in freshly prepared chapattis, After 2 hours of storage. Control sample showed a decline of 3.30 percent in hydration capacity whereas; decrease was negligible in sample containing milk byproduct. The revealed that the effect of storage was

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

significant (P<0.01) in buttermilk replacements. The drop in hydration was significant (p<0.01) only after 48 hours of storage. In an investigation undertaken to study the effect of refreshening procedures on the quality characteristics of stored chapattis prepared with and without liquid buttermilk.

**Table -6 Effect of water replacement with buttermilk on hydration capacity of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 2.42 | 2.34 | 2.4 | 1.61 | 2.2 | 17 |
| 20 | 2.45 | 2.44 | 2.37 | 1.9 | 2.29 | 36.53 |
| 40 | 2.45 | 2.44 | 2.37 | 1.91 | 2.29 | 36.53 |
| 60 | 2.45 | 2.44 | 2.39 | 1.91 | 2.3 | 36.37 |
| 80 | 2.46 | 2.46 | 2.4 | 1.91 | 2.31 | 36.21 |
| 100 | 2.46 | 2.46 | 2.41 | 2.01 | 2.33 | 30.34 |
| Mean | 2.45 | 2.43 | 2.39 | 1.88 | | |
| CV | 0.577 | 1.84 | 0.724 | 7.52 | | |

**Kaur and Bajwa (2000)** observed that the water hydration capacity and soluble solids were found to be affected significantly (P<0.01) with the storage and refreshening treatments.

**Sensory characteristics of chapattis-**

**Appearance scores-** Appearance scores of chapattis have been shown in Table 7. Appearance of chapattis slightly deteriorated with the incorporation of buttermilk in the freshly prepared chapattis. It caused more brownish /blackish spots on the surface of chapattis during baking on the tawa. However, this effect was not reflected in sensory scores which did not differ significantly. Analysis of variance showed that storage resulted in significant (P<0.01) lowering of appearance scores in buttermilk. The appearance of more number of brownish /blackish spot on the surface of chapattis could be because of enhanced maillared reaction due to the presence of more amino group and carbonyl groups and lactose contributed by buttermilk.

**Table -7 Effect of water replacement with buttermilk on appearance scores of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 7.85 | 7.56 | 7.15 | 7.05 | 7.4 | 5 |
| 20 | 7.55 | 7.56 | 7.15 | 7.1 | 7.34 | 3.39 |
| 40 | 7.55 | 7.49 | 7.28 | 7.18 | 7.37 | 2.35 |
| 60 | 7.57 | 7.8 | 7.15 | 7.12 | 7.41 | 4.47 |
| 80 | 7.57 | 8 | 7.17 | 7.15 | 7.47 | 2.14 |
| 100 | 7.58 | 7.72 | 7.42 | 7.2 | 7.48 | 2.95 |
| Mean | 7.61 | 7.69 | 7.22 | 7.13 | | |
| CV | 1.55 | 2.46 | 1.52 | 0.77 | | |

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

Incorporation of buttermilk at 80 percent levels had the best effect on the appearance of chapattis even after being storage for 14 hours.

**Texture score-** Incorporation of buttermilk in dough improved the texture of chapattis, although the effect of incorporation of even higher levels was found to be non significant (Table 8). Improvement in texture of test chapattis may be attributed to the presence of phospholipids as a result of buttermilk incorporate on during dough making. **Swortfigure (1962), Hlynka (1964) and Hertz (1965)** further observed that in baked products containing milk solids, hydrated casein acts as a reservoir of water necessary for the thermal gelation of starch and continue to function in thus, may retard the staling phenomenon. This could be another reason for better textured chapatti having buttermilk/ whey. Storage of chapattis resulted in significant (P<0.01) deterioration of texture Table 8.

Chapattis became hard on storage and thus obtained poor rating for sensory attributes of texture. However obtained poor rating for sensory attributes of texture. However incorporation at 100 percent levels not only improved the texture but also maintained it up to 24 hours. Baking products have a limited shelf life because they undergoes staling phenomenon **(Kulp and Ponte 1981).** The starch fraction is generally considered as the primary factor for the staling of bread, progress of which could be measured by measuring crumb firmness **(Colwell et al., 1969).** Shortening and emulsifier are known to reduce crumb firmness by binding with starch and hence, improve the texture. Therefore, the retention of water and improvement in texture of test chapattis may be attributed to the presence of phospholipids as a result of buttermilk incorporate on during dough making.

**Table -8 Effect of water replacement with buttermilk on texture scores of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 6.7 | 7.01 | 6.02 | 6 | 6.43 | 7.77 |
| 20 | 7.7 | 7.15 | 6.4 | 6.1 | 6.83 | 10.55 |
| 40 | 7.56 | 7 | 6.82 | 6.3 | 6.92 | 7.5 |
| 60 | 7.5 | 7.08 | 6.69 | 6.21 | 6.87 | 7.97 |
| 80 | 7.79 | 7.72 | 6.72 | 6.28 | 7.13 | 10.49 |
| 100 | 7.91 | 7.87 | 6.84 | 6.32 | 7.23 | 10.89 |
| Mean | 7.53 | 7.3 | 6.58 | 6.2 | | |
| CV | 5.78 | 5.3 | 4.8 | 2.04 | | |

**Swortfiguer (1962), Hynka (1964) and Hertz (1965)** further observed that in breads containing milk solids, hydrated casein acts as a reservoir of water necessary for the thermal gelation of starch and continue to function in thus, may retard the staling phenomenon. This could be another reason for better textured chapattis having buttermilk **Indrani et al., (2007)** explored the possibility of using WPC as a functional ingredient in Indian traditional product- South Indian parotta, at 5, 10, and 15 percent. The parottas with 5 percent WPC were rated good. The quality characteristics of parotta were adversely affected beyond 5 percent level of WPC. The microsturcture of the top and middle layer of baked parotta with 5 percent WPC showed that there was a disruption in the continuity of the gluten matrix.

**Mouth Feel Scores-** Mouth feel scores of chapattis as affected by level of buttermilk and storage are presented in Table 9. Mouth feel scores were not affected significantly (P<0.01) though showed some improvement as a result of incorporation of milk byproducts at various levels. However, scores decreased significantly with the storage (P<0.01) . Incorporations of buttermilk and whey at 20 percent levels reflected best mouth feel scores in the freshly prepared chapattis.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 353-361 www.ijaem.net ISSN: 2395-5252

**Table 9 Effect of water replacement with buttermilk on mouth feel scores of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 6.28 | 6.86 | 6.14 | 6.05 | 6.21 | 2.21 |
| 20 | 7.69 | 6.84 | 6.4 | 6.1 | 6.76 | 10.23 |
| 40 | 7.38 | 7.1 | 6.42 | 6.15 | 6.76 | 8.48 |
| 60 | 7.36 | 7.16 | 6.44 | 6.2 | 6.79 | 8.21 |
| 80 | 7.3 | 7.3 | 6.56 | 6.2 | 6.81 | 7.7 |
| 100 | 6.86 | 7.32 | 6.43 | 6.15 | 6.51 | 4.6 |
| Mean | 7.14 | 6.88 | 6.39 | 6.14 | | |
| CV | 7 | 4.82 | 2.15 | 0.892 | | |

**Overall –acceptability-** over all acceptability scores have been presented in Table 10 which are simple averages of appearance, color, texture and mouth feel scores. Over all acceptability of chapattis was not affected significantly with the incorporation of buttermilk in chapatti dough. However, storage had a significant (P<0.01) effect in decreasing the acceptability scores of chapattis.

Overall acceptability as a result of storage while incorporations had almost negligible effect on this trait. **Kaur and Bajwa (2000)** investigated the effect of refreshening procedures on the quality characteristics of stored chapattis prepared with and without liquid buttermilk. The overall acceptability scores were significantly (P<0.01) affected with the levels of buttermilk, storage and reheating process.

**Table 10 Effect of water replacement with buttermilk on overall acceptability scores of chapattis and changes during storage at room temperature**

| Replacement (%) | Storage (Hours) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 24 | 48 | 72 | Mean | CV |
| 0 | 6.94 | 7.04 | 6.44 | 6.14 | 6.64 | 6.38 |
| 20 | 7.64 | 7.18 | 6.66 | 6.36 | 6.96 | 8.12 |
| 40 | 7.49 | 7.19 | 6.84 | 6.4 | 6.98 | 6.71 |
| 60 | 7.47 | 7.34 | 6.76 | 6.4 | 6.99 | 7.15 |
| 80 | 7.38 | 7.37 | 6.81 | 6.45 | 7 | 6.54 |
| 100 | 7.15 | 7.13 | 6.76 | 6.42 | 6.86 | 5.04 |
| Mean | 7.34 | 7.21 | 6.71 | 6.36 | | |
| CV | 3.47 | 1.75 | 2.15 | 1.79 | | |

## IV. CONCLUSION

It was concluded that substitution o water with milk byproducts. Buttermilk facilitated dough handling and baking characteristics of chapattis improved appearance and texture scores. They certainly helped improve the quality characteristics and overall acceptability during storage of the baked products. The augmented incorporation of buttermilk enhanced protein, fat and ash contents in the chapattis so prepared and therefore, improved their nutritional value. This suggested a simple and safe way of better utilization of buttermilk rather than dumping into sewers, sea , rivers and grounds as their disposal is not only a wastage of nutrients but causes environment pollution as well.

## REFERENCES

[1]. AACC(1990) Approved methods. American association of cereals chemists, st paul, Minn, USA.

[2]. G. Chopra and I. Gandhi (1989) improving the nutritional value of bread

and pastry. Khlebopekarnaya I Konditerskaya Promyshlennost 4 : 414-15

[3]. P Tylkin (1975) Effect of wheat bran and polydextrose on the sensory characteristics of biscuits,. Cereal Chem. 67 (6): 545-47.

[4]. C. Hui (1992) Proximate and mineral content of selected baked products. Cereals Food World. 27 (7): 108-13

[5]. Verkateswara Rao (1991) Nutritional evaluation of products prepared from composite flour containing wheat , breadfruit and soybean, peanut flours. J . of Cereal Chem. Vol – 1, 203-207.

[6]. F. Martin (1991) Factors affecting the mixing requirements of a sourdough bread made with acid whey. Baker's Digest 47 (3) :16-18.

[7]. G.W Snedecor and W. Cochran (1968) . Statistical methods, Oxford and IBH Publishing company, New Delhi, pp339

[8]. H. Nutting (1970) Process and additive for producing a rapidly acting bakery dough and the products obtainedAbstr. In FSTA 17 (7): 138.

[9]. R.A Buchanan (1979) The Australian milk biscuits. Agric Sci Rev 9 (1) : 19. (FSTA 3: 11G413, 1971).

[10]. Earlier Bilgin "Properties and composition of Turkish flat bread supplemented with barley flour and wheat bran", J of Food Sci. Vol 4 pp- 45-150, (2006) .

[11]. K Milosz and M. Kowalczuk, "Loaf volume and protein content of hard winter and spring wheat's". Cereals Chem. 25: 291-301, (1989)

[12]. S. Indrani (2007), Studies on the quality of some improved varieties of Indian wheat, J of the Soci. Food Agric, 16, 526.

[13]. S. Eaelier Rao (1986) Non fat dry milk and whey protein concentrate- versatile dairy proteins in economical forms. Food Processing 53 (5): 124-32.

[14]. T. Kaur and N Bajwa (2000) Proximate composition and content of minerals linoleic and tocopherols in soymilks. J Japanease society Fd Sci Tech 37 (4): 293-97.

[15]. A. K Swortfiguer (1962), Utilization of byproducts of dairy industries- whey and buttermilk. Indian dairyman 37(11)507

[16]. N. Hynka (1964) and B. Hertz (1965) Rheological characteristics of dough for the production of special Azerbaidzhan bread. J Food Sci , Vol -27:pp 233.