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# Assessment Of Standard Chapatti Testing Method And Finding Factors Affecting Chapatti Quality

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**Abstract**

Chapati is the staple food of people in Indian subcontinent. Despite a heavy consumption of chapati, the commercial status of this food product has not yet been to the par. Standardization of chapati making is yet in the process of development. The assessment of present chapati testing method was performed by standard method publisheb by Haridas Rao et. a., (1986). 6 indian wheat cultivars and one standard commercial wheat flour were assessed for chapati making. Correlation study was done to find the physico-chemical factors that affect chapati quality. The total chapatti score was affected by moisture, gluten content, eating quality and the taste of the chapatti. Absorption was affected by the gluten. Dough development time and its stability were positively correlated. The present scoring method has many subjective parameters which add to the standard error in scoring method. The objective parameters like pliability and puffing were objective parameters and best suited for screening of chapati quality. There is a need to improve the test and reduce the number of subjective parameters so that chapati testers can test and reproduce the results at any place.

**Key words**

Chapatti, rheology, testing, quality, dough development

## Introduction

Chapatti is a popular flat bread in many countries of Indian ethnicity. It is typically made with whole-meal ground on stone disc mills. Roller milling has been used to produce flours at various levels of refinement in recent years. Indians consume wheat majorly in form of chapatti (Safdar et al., 2009) and preferred to be eaten fresh (Mehfooz et al., 2018). Because of the presence of bran, it has a soft texture and a duller appearance. It is a primary source of prophylactic food source against several health disorder (Jacobs et al., 1998; Slavin et al., 2000; Thompson, 1994).

Moisture, protein, gluten content, all play a role in the end-use quality of wheat-based products (Huebner et al., 1995; Peterson et al., 1992; Schofield, 1994). These parameters affect the machinability of the end product. The gluten and starch matrix, controls the rheology of the dough (Mikhaylenko et al., 2000). The components of whole wheat and white wheat flour used in breads are different, wherein bran and germ play vital role in different rheological parameters in both types of wheat flours. The tests to determine the rheology of whole-meal flour dough can determine the efficacy of the specific four in chapatti quality forecasting.

There has been a lot of research done on testing chapatti after baking, subjective or objective evaluation, and scoring systems of specific Indian flat breads (Faridi et al., 1981). There are some advancements in the instruments to measure the quality of chapatti, but the testing method needs refinements. The current study aimed to assess the relationship between whole meal flour properties, dough properties, and chapatti sensory, textural characteristics and assess the efficacy subjective and objective testing parameters of standard chapatti testing method.

## Materials and methods

The physicochemical, rheological, and baking properties of six wheat cultivars (Lok-1, Kedar, Gold 23, HD2189, Trimbak and Samadhan) and a commercial wheat flour of Sihore sharbati procured from “Ashirwad ata” were tested for evaluation. The moisture content of grain samples was determined using the air oven method (AACC methods 44-15A) and was found to be within a narrow range (9.4-10.4 percent). The samples were milled in common disc mill which is specifically used for chapatti making throughout India. The four was sifted using 0.8 mm sieve and the bran was found to be 3 %. This flour was rested for 5 hours until cooled. This cooled flour was used for flour moisture content estimation. The flour moisture was necessary to take any tests on 14 % moisture basis.

### Determination of physicochemical properties and dough formation

The physicochemical properties of whole-meal flour were evaluated using 'American Association of Cereal Chemists' approved methods. AACC methods 44-15A, 38-12 and 08-01, were used to determine moisture content, wet gluten content and index, and ash content respectively (AACC, 2000). Crude protein content was determined using AACC 46-10-01 method.

Prior to dough formation, salt, and groundnut oil (1 percent and 5%, respectively) were added to each cultivar's flour. The dough was prepared by manually mixing after adding a fixed amount of water. All the measurements of water addition were done on 14 % moisture basis of the flour. After the addition of water, the

dough was kneaded to a desired consistency. Phillips HR-7915 was used for dough preparation so that all the flours under test had a consistent dough treatment. All the doughs were prepared of similar consistency and the water needed for the dough formation was measured. The dough preparation was done by gradually adding water to the dough and kneading the dough in dough maker until the dough attained desired consistency and left its sticky consistency. The water needed for optimal rheological trait was expressed as percent water needed for dough development. The amount of time needed to make the dough in machine was noted as dough development time. After the dough reached the dough development time, the dough was later kneaded until the dough started breaking and sticking to the walls of the dough maker. This was noted as dough stability time.

For testing of chapatti, the whole wheat flour of all the cultivars were mixed for the optimal dough development with optimal water. After the dough formation, it was placed in a bowl and covered with cling wrap for 15 minutes to stabilize it.

**Preparation of chapatti**

A rounded 40 g of dough was placed in the centre of a specially designed wooden platform. A wooden roller was used to roll out the dough. The chapatti was then folded in quadrants and then rerolled to make round chapattis. The chapatti was rolled down to the thickness of 2 mm as mentioned by Haridas Rao et al., 1986. The same standard method was used to cook the chapatti. For puffing, the chapatti was partially cooked on both sides and immediately placed on flame. The chapatti was puffed in not more than 4 seconds. Before further analysis, the chapatti were stored in a resealable plastic bag at room temperature to avoid moisture loss.

**Sensory and textural evaluation of chapattis**

The sensory evaluation of chapattis prepared from various cultivars was carried out (Haridas Rao et al., 1986). As a result, each sample was presented in random order to the 6 judges. The chapatti scoring was done as per standard method (Haridas Rao et al., 1986). The test chapatti was kept unknown to the chapatti testers to remove the error bias while evaluation.

**Statistical analysis**

Means of triplicate readings of the tests were recorded, and the results were reported as means with standard deviations. Pearson's correlation coefficients between chapatti quality parameters and whole meal flour properties were calculated to determine which quality parameter of wheat has the most influence on chapatti quality. Post hoc LSD was used to find significant differences in the means at 0.05 level of significance. All statistical calculations were done using IBM SPSS ver. 24.

**Results and discussion**

**Physicochemical and dough characteristics of whole meal flour**

Table 1 displays the physicochemical and rheological properties of wheat whole meal flours. Wheat flour samples were in the desirable range as per the recommended guidelines of grain storage. Protein levels were also within the range of 12.4 to 13.2 %. The protein content of wheat grains is affected by genotype, environment, and effect of their combined interaction (Zhu and Khan, 2001). But this bias was eliminated by

growing all the cultivars at same location and harvested in same season. This reduced the chances of varietal biochemical variations that might occur due to subtle variations in the expression by environment.

The wet gluten content ranged from 24.0 to 32.8.0 %. Wheat cultivars had medium to high gluten strength. Water absorption was approximately 70 % in all whole-meal flours, which is an index for good chapatti making (Rehman et al., 2007). Comparatively, the cultivar Samadhan had the highest water absorption percent. The cultivar Samadhan also had the lowest mixing time whereas Lok-1 had the highest of 4.9 minutes. Dough development time in wheats of different hardness have different mixing times (Zhu and Khan, 2001). Lok-1 whole wheat flour dough was significantly more stable to mixing than other wheat cultivars. The genotype, environment, and crop year all have a significant impact on wheat cultivar dough stability (Chun et al., 2007).

**Table 1 Physico-chemical and dough properties of whole wheat flour of different cultivars.**

| Quality parameters | Ashirwadata (control) | Lok-1 | Kedar | Gold 23 | HD2189 | Samadhan | Trimbak |
|---|---|---|---|---|---|---|---|
| Moisture (%) | $10.1^{a} \pm 0.12$ | $9.8 \pm 0.12$ | $9.3^{ac} \pm 0.12$ | $9.9^{c} \pm 0.12$ | $9.8 \pm 0.12$ | $9.4^{af} \pm 0.12$ | $10.0^{cf} \pm 0.12$ |
| Crude Protein | $12.9^{a} \pm 0.12$ | $12.4^{b} \pm 0.12$ | $13.2^{bc} \pm 0.12$ | $13.1^{b} \pm 0.12$ | $12.2^{ac} \pm 0.12$ | $13.2^{b} \pm 0.12$ | $13.0^{b} \pm 0.12$ |
| Wet Gluten | $30^{a} \pm 1.15$ | $24^{ab} \pm 1.15$ | $27.2^{c} \pm 1.15$ | $30.1^{b} \pm 1.15$ | $25.7^{d} \pm 1.15$ | $25.3^{e} \pm 1.15$ | $32.8^{bcde} \pm 1.15$ |
| Gluten Index | $67 \pm 1.15$ | $86^{a} \pm 1.15$ | $80 \pm 1.15$ | $55^{b} \pm 1.15$ | $88^{a} \pm 1.15$ | $51^{b} \pm 1.15$ | $73 \pm 1.15$ |
| Ash Content (%) | $1.2^{a} \pm 0.06$ | $1.7^{ab} \pm 0.06$ | $1.9^{ac} \pm 0.06$ | $1.8^{ad} \pm 0.06$ | $1.8^{b} \pm 0.06$ | $1.4^{abcd} \pm 0.06$ | $1.7^{a} \pm 0.06$ |
| Water Absorption (%) | $71.4 \pm 0.58$ | $70.4 \pm 0.58$ | $70.0 \pm 0.58$ | $71 \pm 0.58$ | $69.4 \pm 0.58$ | $72.6 \pm 0.58$ | $69.6 \pm 0.58$ |
| Dough Development Time (Min) | $4.0^{a} \pm 0.17$ | $4.9^{ab} \pm 0.17$ | $3.5^{bc} \pm 0.17$ | $3.6^{bd} \pm 0.17$ | $4.5^{cd} \pm 0.17$ | $3.0^{ab} \pm 0.17$ | $2.5^{abcd} \pm 0.17$ |
| Dough Stability (Minutes) | $5.0^{*} \pm 0.17$ | $7.5^{@} \pm 0.17$ | $5^{*} \pm 0.17$ | $4.0^{\#} \pm 0.17$ | $8^{@} \pm 0.17$ | $3 \pm 0.17$ | $3.5^{\#} \pm 0.17$ |

Any mean followed by ± is the standard error of the mean. The means in rows followed by a superscript alphabet are significantly different means at 0.05 level of significance as found by post hoc LSD. In dough stability, the means with special characters as superscript are similar means, whereas others are significantly different.

**Subjective and objective evaluation of chapattis**

A good chapatti should have an appealing colour with even light brown spots, a smooth, soft, and pliable hand feel, the desired soft chewing quality, and a slow evolving sweetish taste on chewing as mentioned by Haridas Rao et al., (1986). It should puff the fullest separating out two laminae with a wheaty aroma. The sensory and objective evaluation of the chapatti made from whole-meal flours of 6 wheat cultivars are showed in table 2. Since all the wheat cultivars were bred for Indian use, all received good or excellent ratings, which was approximately 70 out of 100. Kedar and Samadhan were the leading cultivars with scores more than 80. Trimbak had the lowest overall score of 68.8. The puffing score was highest of Gold 23 as 9.8 and lowest of HD 2189. The pliability was highest of samadhan as 8.5 and lowest of HD 2189. The appearance scire was best of Samadhan as 16.5 and lowest of Trinbak with 12. The hand feel was highest for Gold 23 as 7.3 and lowest

for Trimbak (4.5). The eating quality was highest for Kedar as 22.7 and lowest for Gold 23 (11.3). The taste score was highest for kedar as 22.3 and lowest for Trimbak.

The post hoc analysis of the results showed that the puffing, and pliability didn't have much of difference and the standard error of the mean was also very low. This is because puffing and pliability are objective scoring methods and are repeatable. These tests don't vary with person and hence best tests to measure the chapatti quality. However, as the test moves towards objective scoring, there was a greater standard error in the means. This corresponded to greater variability by the testers. Hand feel of Trimbak was very different from that of any other cultivar. The parameters which had lower points had correspondingly greater standard error as compared to eating quality or taste, which had points of 25. A very high standard error was found in the taste score of Gold 21. The total score of the chapattis consequently also had a very high standard error.

The results show that chapatti testing method implied in this research (which is the only published standard method) has many subjective scoring parameters which vary as per the tester. Despite the chapattis made out of similar procedure many cultivars had variable chapatti scores. These cultivars were at some time the best selling cultivars and bred specifically for chapatti making. It is essential that the chapatti testing parameters be screened using mechanical instruments so that the repeatability of the testing can be increased. There are several texture analysis machine which can be used to test chapatti for its quality.

**Table 2 Evaluation of chapatti quality by standard method**

| | Puffing score (10) | Pliability (10) | Appearance (20) | Hand feel (10) | Eating quality (25) | Taste (25) | Total |
|---|---|---|---|---|---|---|---|
| Ashirwad ata (control) | 9.0 ± 0.45 | 7.3 ± 0.21 | 13.8 ± 0.79 | 6.3 ± 0.42 | 14.0 ± 0.26 | 20.2 ± 0.48 | $70.7^{@}$ ± 0.88 |
| Lok-1 | 9.7 ± 0.21 | 7.5 ± 0.22 | 14 ± 0.93 | $6.8^{a}$ ± 0.48 | $20.3^{@}$ ± 0.21 | $20.7^{b}$ ± 0.21 | $79.0^{\#}$ ± 1.03 |
| Kedar | 9.5 ± 0.34 | 7.7 ± 0.21 | 13.8 ± 1.25 | $7.0^{b}$ ± 0.58 | 22.7 ± 0.21 | $22.3^{cde}$ ± 0.21 | $83.0^{\#}$ ± 1.44 |
| Gold 23 | 9.8 ± 0.17 | 8.5 ± 0.22 | 14.7 ± 1.17 | $7.3^{c}$ ± 0.67 | 11.3 ± 0.21 | $19.3^{c}$ ± 1.02 | $71.0^{@}$ ± 2 |
| HD2189 | 8.3 ± 0.21 | 7 ± 0.26 | 14.5 ± 0.92 | $7.3^{d}$ ± 0.49 | $21.3^{@}$ ± 0.33 | 20.5 ± 0.22 | $79.0^{\#}$ ± 1.18 |
| Samadhan | 9.2 ± 0.4 | 8.5 ± 0.22 | $16.5^{a}$ ± 0.56 | $7.0^{e}$ ± 0 | $20.3^{@}$ ± 0.21 | $19.7^{cf}$ ± 0.33 | $81.2^{\#}$ ± 1.35 |
| Trimbak | 8.3 ± 1.48 | 7.3 ± 0.21 | $12.0^{a}$ ± 1.03 | $4.5^{abcde}$ ± 0.34 | 18.3 ± 0.21 | $18.3^{bef}$ ± 0.21 | $68.8^{@}$ ± 1.64 |

The means followed by ± is the standard error of the mean. The means followed by common superscript alphabets in the columns are significantly different means as found by post hoc LSD at 0.05 level of significance. Any means followed by superscript special characters are similar means.

**Influence of flour physicochemical properties on chapatti quality**

The multiple correlation analysis found that moisture had a significant correlation multi total chapati score. protein affected the dough development time as well as the dough stability but didn't affect the total

chapati score. The gluen index gave a very high positive correlation with the water absorption and pliability. The wet gluten had a strong positive correlation with total chapatti score. Ash didn't seem to have any correlation with any physicochemical parameter. it can be concluded that ash might only be affecting the colour but doesn't have an impact on chapati total score. the water absorption however watch correlated with the gluten content. Dough development time was dependent on the protein content and a higher dough development time correspondent to a higher dough stability (Table 3).

Many parameters of chapati score itself were interconnected to each other. We handfield and appearance seem to have a positive correlation. The eating quality and taste was also found to positively correlate with the total chapati score. According to this study, the sensory and textural characteristics of chapatti are related to the quality of whole meal flour. The level of influence of the quality parameter, on the other hand, ranged from negligible to significant. Gluten content and quality were discovered to be the most influential parameters on chapatti acceptance quality. The data gathered would be useful for wheat breeding programmes aimed at developing

**Table 3 Multiple correlation of different physico-chemical parameters and chapatti scores**

| | Moisture | Protein | Wet Gluten | Gluten Index | Ash | Absorption | DDT | Dough Stability | Puffing | Pliability | Appearance | Handfeel | Eating Quality | Taste | TCS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture | 1 | | | | | | | | | | | | | | -.878** |
| Protein | | 1 | | | | | -.786* | -.920** | | | | | | | |
| Wet Gluten | | | 1 | | | | | | | | | | | | -.858* |
| Gluten Index | | | | 1 | | -.859* | | | | -.824* | | | | | |
| Ash | | | | | 1 | | | | | | | | | | |
| Absorption | | | | -.859* | | 1 | | | | | | | | | |
| DDT | | -.786* | | | | | 1 | .902** | | | | | | | |
| Dough Stability | | -.920** | | .837* | | | .902** | 1 | | | | | | | |
| Puffing | | | | | | | | | 1 | | | | | | |
| Pliability | | | | -.824* | | | | | | 1 | | | | | |
| Appearance | | | | | | | | | | | 1 | .757* | | | |
| Handfeel | | | | | | | | | | | .757* | 1 | | | |
| Eating Quality | | | | | | | | | | | | | 1 | | .793* |
| Taste | | | | | | | | | | | | | | 1 | .757* |
| TCS | -.878** | | -.858* | | | | | | | | | | .793* | .757* | 1 |

TCS is total chapatti score, DDT is dough development time. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

flat bread cultivars, as well as semi-mechanical commercial units for chapatti processing.

## Conclusion

The wheat flours used int the chapatti testing experiments gave good chapatti quality. The results found that the chapatti quality depended a lot on the physico-chemical parameters of the wheat flour. The chapatti assessment done on objective scoring had a very low standard error as compared to subjective scoring parameters. The subjective scores like hand feel, taste, eating quality varied significantly with the reviewers. It is essential to modify the testing method and introduce modern mechanized methods to assess the chapatti quality.

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