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SHORT COMMUNICATION

Sensory Analysis of *Chappati*: Consumer Preferences for Conventional, Organic, and Biofortified Wheat Flour

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ABSTRACT
The raised concerns over environmental sustainability and the negative impacts on human health have increased interest in modern wheat types as more sustainable and nutritious alternatives. The present study was undertaken to develop Chappati using different types of wheat flour namely conventional wheat flour, organic wheat flour, and bio-fortified wheat flour. Thereafter, the acceptability was assessed through a 9-point hedonic scale for fresh and after storage of 4 hours. The statistical analysis of sensory evaluation data revealed that organic wheat flour was significantly (P<0.05) preferred for its color, tearing properties, and taste. Both innovative wheat variety flour base Chappati were accepted by the panelists. Storage for 4 hours affected acceptability but only moderately, making both innovative varieties suitable for consumption in a lunchbox. The study provides an opportunity for policymakers and food scientists to promote the production of organic and biofortified wheat.
Keywords: *Biofortification, Chappati, Health Benefits, Organic, Wheat.*

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INTRODUCTION

India, as the second-largest wheat consumer globally after China, underscores the significance of this cereal in human nutrition. Wheat cultivation occupies a substantial portion of India's agricultural landscape, second only to paddy, covering approximately 25% of the total cereal crop area. This extensive cultivation reflects the integral role of wheat in the Indian diet [1]. Within India, wheat flour finds its primary utilization in the production of *Chappati*, a staple food commonly known as *Roti*. Remarkably, an estimated 90% of the wheat produced in India is destined for *Chapatti* consumption, with only a minor fraction allocated to other wheat-based products such as bread, biscuits, and cakes [2,3]. This dominance of *Chappati* in the Indian diet highlights its cultural and nutritional significance. *Chappati*, as the primary form of wheat consumption in India, play a crucial role in ensuring adequate nutrition [4]. The quality of *Chappati*, in turn, is significantly influenced by the characteristics of the wheat used in their preparation. Desired qualities in a chapatti include pliability, puffability, softness, a light creamish-brown color, slight chewiness, and a distinct baked wheat aroma [5,6]. Each stratum of the population in India relishes packed lunch in the form of *Chappati* which signs towards safer food habits [7].

Traditional wheat production methods often rely heavily on high-yielding varieties, coupled with the extensive use of chemical fertilizers, pesticides, and mechanization [8,9]. While these practices have boosted yields, they have raised concerns about environmental sustainability and the potential for negative impacts on human health and have emphasized the need for innovative approaches to wheat production and consumption. This has increased interest in organic and biofortified wheat varieties as more sustainable and nutritious alternatives. Organic wheat, cultivated without the use of synthetic

fertilizers and pesticides, offers a more environmentally friendly approach to wheat production [10]. Biofortified wheat varieties, on the other hand, offer a potential solution to address micronutrient deficiencies while maintaining or even improving the yield and quality of the crop [11]. The process of biofortification utilizes knowledge of plant breeding, agronomic practices, and biotechnological approaches.

Despite the growing interest in organic and biofortified wheat, consumer preferences still favor conventional wheat varieties. This preference may be attributed to several factors, including a lack of awareness about the benefits of alternative wheat types, concerns about potential differences in taste and texture, and limited availability of these varieties in the market.

This research aims to investigate the sensory characteristics of *Chappati*s (as fresh and after storage) made from different wheat varieties, including conventional, organic, and biofortified wheat. The study will focus on assessing consumer preferences for these different chapatti types and identifying the key sensory attributes that influence consumer acceptance.

MATERIAL AND METHODS

The present study was done in the department of Department of Nutrition and Dietetics, Manav Rachna International Institute of Research and Studies, Faridabad Haryana. The methodology opted for the present study is mentioned below:

Procurement of raw material: For the present study conventional wheat flour, organic wheat flour, and biofortified flour (zinc and iron-fortified) was purchased from the local market.

***Chappati* preparation:** To prepare *Chappati*, wheat flour was kneaded, and water used for each type of flour to make dough of similar texture was measured to calculate water absorption. The extensibility of dough was measured manually. Care was taken to roll out *Chappati* of similar thickness, and cooking time was also controlled.

Sensory evaluation: Twenty-five semi-trained panelists and twenty-five untrained panelists from the Department of Nutrition and Dietetics, School of Allied Health Sciences, Manav Rachna International Institute of Research and Studies, Haryana, assessed the sensory attributes of *Chappati* in terms of color, tearing property, aroma, taste, texture and overall acceptability. A nine-point hedonic scale, with 9 indicating extremely liked and 1 indicating extremely disliked was used. Since packed lunch is very common in India, sensory evaluation was also performed after 4 hours of *Chappati* making so that changes in quality attributes could also be documented. For this, *Chappati* were stored in casseroles.

Statistical analysis

The IBM Statistical Package for Social Sciences (SPSS) Statistics 28.00 software (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. The study results were expressed as mean ± standard. The results of the sensory evaluation were analyzed by one-way ANOVA.

RESULTS AND DISCUSSION

Table 1 presents the water absorption capacity for dough making. The data reveals that organic wheat flour absorbed the least water (50 ml) to make a standard dough, while conventional wheat flour used a maximum i.e. 70 ml of water for 100g of flour.

The variation in water absorption may be because of varying gluten content as reported by Panghal *et al.* [12].

Table 2 presents the sensory evaluation of *Chappati* prepared from conventional wheat flour, organic wheat flour, and biofortified wheat flour. It is evident from the data that a storage time of 4 hours impacted the scoring of color, tearing property, aroma, taste, and overall acceptability of different *Chappati* samples.

In the case of color, there was a significant difference between the color of *Chappati* prepared from conventional wheat flour and organic wheat flour (7.62 ± 1.04 and 7.94 ± 1.31, respectively).

After 4 hours of storage, there was a reduction in sensory scores for colour (7.00 ± 1.44 and 7.90 ± 1.14, respectively). This may be due to differences in the colour of wheat. Research data reports the same and states that dough color directly affects the chapatti color and overall quality score. The colour of *Chappati* may also vary because of variations in gluten content [12].

In the case of tearing property, a similar trend was observed. All samples were rated moderately liked (7). There was a significant difference ($P<0.05$) between the tearing property of *Chappati* prepared from whole wheat flour and organic wheat flour (7.54 ± 1.05 and 7.68 ± 1.21). Among all samples of *Chappati*, scoring of tearing property had an influence of storage. As evident from the table, there was a reduction in scores in the case of conventional wheat flour and bio-fortified wheat flour. While scoring remained the same in the case of organic wheat flour. Similar results were obtained by Yousaf *et al.* [13]. The study

highlighted that a reduction in the extensibility of chapatti is common during storage with an increase in the fiber content of wheat flour, an increase in the hardness of chapatti has been reported earlier [14-16].
The aroma of all three samples was liked by panellists. There was no report of any special aroma from organic wheat *Chappati* or biofortified *Chappati*. The trend remained the same even after storage though aroma rating reduced slightly. There was a significant ($P<0.05$) difference between aroma rating of *Chappati* samples prepared from conventional wheat flour, organic wheat flour *Chappati*, and biofortified wheat flour. Storage temperature plays an important role in determining the rate of staling. Chapattis stored at room temperature tend to stale more rapidly than that of stored at refrigerated temperature [17].
A similar trend was observed for the attributes of taste where all three samples of *Chappati* had significant differences.
Overall acceptability scoring revealed that all three samples of *Chappati* were scored differently as per the statistical analysis (at 5 percent significant level). The conventional wheat flour was scored more followed by organic wheat flour and biofortified wheat flour. It is the point of highlighting that overall acceptability was reduced with storage but the impact was more on the acceptability of whole wheat flour, and biofortified wheat flour, while organic wheat flour was rated the same even after storage. Similar results were observed in the study by Sharma *et al.* [18] who worked on *Chappati* development from 6 different wheat types grown under different conditions. It was reported that organic wheat flour *Chappati* was most liked by panelist as compared to other types grown in mixed conditions using fertilizers and organic manures.

CONCLUSION

In conclusion, this research will contribute to a better understanding of consumer perceptions and preferences for *Chappati*s made from different wheat varieties. By bridging the gap between research and consumer acceptance, this study will pave the way for the wider adoption of organic and biofortified wheat varieties, thereby promoting sustainable agriculture and improving public health in India.

Table 1 Percent water absorption by different wheat flours

Type of wheat flour	Amount of flour	Water used	Weight of dough	% Water absorption
Conventional wheat flour	100 gm	70 ml	174.0	74
Organic wheat flour	100 gm	50 ml	163.5	63.5
Biofortified wheat flour	100 gm	60 ml	155.0	55

Table 2. Sensory acceptability of *Chappati* prepared from different wheat varieties

COLOR			
Sample	**Conventional wheat flour**	**Organic wheat flour**	**Bio-fortified wheat flour**
FRESH	7.62 ± 1.04^{b}	7.94 ± 1.31^{a}	7.34 ± 1.09
AFTER 4 HOURS	7.00 ± 1.44^{b}	7.90 ± 1.14^{a}	7.04 ± 1.05
Tearing property			
FRESH	7.54 ± 1.05^{b}	7.68 ± 1.21^{a}	7.2 ± 1.16
AFTER 4 HOURS	5.8 ± 1.92^{bc}	7.60 ± 1.26^{ac}	6.76 ± 1.27^{a}
Aroma			
FRESH	7.62 ± 0.96^{b}	7.50 ± 1.40^{ac}	7.30 ± 1.03^{b}
AFTER 4 HOURS	6.60 ± 1.44^{b}	7.34 ± 1.36	6.92 ± 1.46
Taste			
FRESH	7.52 ± 0.99^{b}	7.66 ± 1.33^{a}	7.30 ± 1.07^{b}
AFTER 4 HOURS	6.56 ± 1.74^{b}	7.62 ± 1.51^{a}	6.76 ± 1.53^{b}
Overall acceptability			
FRESH	7.86 ± 0.85^{b}	7.68 ± 1.34^{ac}	7.40 ± 1.12^{b}
AFTER 4 HOURS	6.58 ± 1.61^{b}	7.30 ± 1.19^{ac}	6.90 ± 1.38^{b}

Values are expressed as mean ± SD. Values with different letters in each column are significant at P<0.05 while Mean ± SD in a column without letter are not significantly different (p<0.05)

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DISCLAIMERS

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and

completeness of the information provided but do not accept any liability for any direct or indirect losses resulting from using this content.

CONFLICT OF INTEREST
Nil

INFORMED CONSENT
No animal/human trial done

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