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## Color Tonality and Sensory Response of Psyllium Husk Based Cookies

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**Abstract:** Fiber based foods are gaining interest to cure health related ailments in human. In present investigation, dietetic cookies were prepared from psyllium husk with 5, 10, 15, 20, 25% along with control for color tonality and sensory response acceptability at 0 to 60 days, respectively. Results regarding color tonality revealed that dietetic cookies showed significant variations with the addition of psyllium husk. The L\* value of the cookies decreased with the addition of psyllium husk while a\* and b\* values were increased. However, storage of 60 days of the dietetic cookies showed significant increase in L\* value whilst a\* and b\* values were decreased. Sensory response like color, flavor, taste, texture and overall acceptability of the psyllium husk cookies revealed the significant reduction with the addition of husk. However, 10, 15, 20% addition of psyllium husk in the cookies showed statistically at par results expect for texture. In conclusion, addition of 20% psyllium husk cookies was acceptable with respect to color tonality and sensory response that may help to fulfill the daily dietary fiber requirements.

**Key words:** Psyllium husk, dietetic cookies, color tonality, sensory response, dietary fiber

### INTRODUCTION

For supplementation of fiber, cookies are appreciated by the consumers due to appealing taste and better storage stability. Bakery products are prepared from different dosage of psyllium husk and previous literature suggested that replacement of psyllium husk up to 50% is possible without detrimental change in quality (Ganji and Kuo, 2008). Results regarding hedonic response showed a declining trend in all sensory parameters with gradual increase of fiber thereby minimum value was observed in treatment containing 30% flaxseed flour (Hussain *et al.*, 2006).

Various fiber sources are used in product development phase with varying objectives like texture development, reduced caloric value and of course their valuable physiological effects. Bioactive profile of different fiber sources is also important like Arabinoxylan (AX) that not only improving the quality of baked products but also with pronounced therapeutic potential. The functional and nutraceutical foods containing fiber are being developed and studied for their effectiveness with special reference to bakery products, yogurt and drinks (Perrigue *et al.*, 2009; Toma *et al.*, 2009).

Dietary fiber exerts a number of health benefits. It is a food source for human colonial flora and host as well. Physiologically, it is important in increasing the mucosal growth and functioning. Likewise, it manages the glycemic indices, serum lipid profile and blood pressure. Moreover, it has proven protective against colorectal, prostate and breast cancers and improves the availability of minerals like Fe, Zn, Mg and Ca (Bengmark, 2010; Tamura *et al.*, 2011).

Color is the first eye observation and foremost criterion for acceptance of a food product. Cookies and burritos were examined by Toma *et al.* (2009) for color tones and texture using colorimeter and texture analyzer, respectively. The values for selected parameters were measured for both products in two forms. One was control using white wheat flour and the other with addition of fiber. Results regarding color elucidated that fiber added cookies were darker when compared with control with L\* value. Similar result was explicated in burritos showing the L\* values for treated and controlled cookies, respectively. The a\* value comparison results indicate that both treated products displayed more red color than that of control. Earlier, Friend *et al.* (1992) indicated that tortillas prepared with whole wheat flour are red and darker as compared to white flour and inferred that it is due to the presence of bran in whole wheat flour.

Present investigation was designed to evaluate the sensory response of psyllium husked based cookies prepared with various concentrations to fulfill the daily dietary requirements.

### MATERIALS AND METHODS

Psyllium husk is becoming popular as therapeutic agent against various physiological ailments. Accordingly, research study was conducted in Postgraduate Research Laboratory, National Institute of Food Science and Technology (NIFSAT), University of Agriculture, Faisalabad, Pakistan.

**Procurement of raw materials:** Indigenous psyllium husk (*Plantago Ovata* Forsk) was purchased from

Qarshi Industries (Pvt.) Ltd. Pakistan. For the preparation of dietetic cookies, non-nutritive sweeteners including aspartame and sorbitol were used. The sweeteners, straight grade flour and shortening were procured from the local market.

**Product development:** Preliminary trials were conducted for the development of dietetic cookies supplemented with psyllium husk. The rationale was to obtain an acceptable quality product. After fixing the recipe, different treatments of cookies were made and evaluated for various quality traits.

Table 1: Different treatments of dietetic cookies

Treatments	Flour (%)	Psyllium husk (%)
T <sub>0</sub>	100	-
T <sub>1</sub>	95	5
T <sub>2</sub>	90	10
T <sub>3</sub>	85	15
T <sub>4</sub>	80	20
T <sub>5</sub>	75	25

T<sub>0</sub> = Control

**Preparation of dietetic cookies:** Six different treatments of cookies were prepared using varying levels of psyllium husk (Table 1) according to the instructions of AACC (2003). The recipe followed for control was: 500 g commercial straight grade flour (CSGF), 250 mL sorbitol, 0.84 g aspartame, 220 g vegetable shortening and 7 g baking powder.

All the treatments were analyzed fortnightly from 0 day to two months storage for physical, chemical and sensory characteristics with the objective to select the best treatment.

**Color tonality:** Color tonality was observed by the method of Rocha *et al.* (2003). For color hue, L\* (lightness), a\* (-a greenness, +a redness) and b\* (-b blueness, +b yellowness) values were recorded using CIE-Lab Color Meter (CIELAB SPACE, Color Tec- PCM, USA).

**Sensory evaluation:** Sensory evaluation of cookies for various attributes like color, flavor, taste, texture and overall acceptability was carried out on fortnightly basis for two months using 9 point hedonic scale system by following the instructions of Meilgaard *et al.* (2007). The cookies were presented to trained taste panel in transparent plates and implicated randomly to avoid biasness. The judges were requested for mouth wash prior to each sample with warm water to avoid any after taste of seasoned samples. The panelists rated the product for their strongly liking to strongly disliking by giving scores from 9 to 1, respectively.

## RESULTS AND DISCUSSION

**Color tonality:** Color tonality of cookies was evaluated through estimation of L\*, a\* and b\* values. Statistical

Table 2: Mean squares for color tones (L, a\* and b\*) in dietetic cookies

SOV	df	L	a*	b*
Treatments (A)	5	287.0320*	21.5050**	9.030**
Storage (B)	4	1.2988*	0.3460*	0.159*
A*B	20	0.0220*	0.0299*	0.002*
Error	60	0.0006	0.0001	0.0006
Total	89			

\* = Significant; \*\* = Highly significant

Table 3: Effect of treatments on color tonality of dietetic cookies

Treatments	Color tones		
	L*	a*	b*
T <sub>0</sub>	59.82±0.13a	2.76±0.08f	26.75±0.09f
T <sub>1</sub>	57.87±0.11b	3.62±0.08e	27.43±0.07e
T <sub>2</sub>	56.05±0.10c	3.94±0.08d	27.85±0.07d
T <sub>3</sub>	53.36±0.13d	4.62±0.07c	28.21±0.07c
T <sub>4</sub>	50.62±0.15e	5.00±0.14b	28.54±0.06b
T <sub>5</sub>	48.39±0.13f	6.20±0.08a	28.88±0.07a

Mean values carrying same letters in a column are not significantly different. T<sub>0</sub> = Control; T<sub>1</sub> = 5% of psyllium husk; T<sub>2</sub> = 10% of psyllium husk; T<sub>3</sub> = 15% of psyllium husk; T<sub>4</sub> = 20% of psyllium husk; T<sub>5</sub> = 25% of psyllium husk

Table 4: Effect of storage on color tonality of dietetic cookies

Storage (Days)	Color tones		
	L*	a*	b*
0	54.72±0.12a	4.56±0.06a	28.06±0.04a
15	54.50±0.12a	4.39±0.05b	28.01±0.04a
30	54.33±0.12ab	4.34±0.05b	27.94±0.04b
45	53.60±0.13b	4.17±0.05bc	27.87±0.04b
60	53.05±0.13b	4.01±0.05c	27.34±0.04c

Mean values carrying same letters in a column are not significantly different

data presented in Table 2 regarding these traits indicated significant differences due to treatments and storage.

**L\* value:** Data regarding L\* value as explicated in Table 3 showed that means for this trait was found maximum 59.82±0.13 in control (T<sub>0</sub>) while the minimum 48.39±0.13 was recorded in cookies containing 25% psyllium husk (T<sub>5</sub>) indicating progressive decline for this trait. Storage (Table 4) showed momentous differences; at beginning L\* value was 54.72±0.12 that reduced to 53.05±0.13 at the end of storage.

Decreased L\* value in the supplemented cookies indicating darker color might be due to gradual increase of psyllium husk in respective treatments. Darkening of color owes to addition of husk as fiber is considered a promising factor in the tonality of bakery products. Similarly, darker hue due to fiber supplementation in tortillas and cookies was reported by Friend *et al.* (1992) and Toma *et al.* (2009), respectively.

**a\* value:** In treatments, means for a\* value depicted in Table 3 indicated increasing trend by adding up of psyllium husk. Means recorded for a\* value was 2.76±0.08 in T<sub>0</sub> that increased progressively to

6.20±0.08 in T<sub>5</sub>. The values were not maintained during storage as shown in Table 4 and declined from 4.56±0.06 at initiation to 4.01±0.05 at the completion of study.

Continuous increase of a\* value in supplemented cookies demonstrated more reddish color in the end product owing to supplementation of psyllium husk. Earlier, Toma *et al.* (2009) also found similar results in cookies and burritos and inferred this effect because of adding fiber.

**b\* value:** Regarding the effect of treatments on b\* value of dietetic cookies, means showed an increasing trend (Table 3). The b\* value noted for control was 26.75±0.09 that increased to 28.88±0.07 in T<sub>5</sub>. Significant diminishing trend in b\* value as function of storage was observed (Table 4). Results indicated the highest value 28.06±0.04 at zero day whilst the lowest 27.34±0.04 at 60<sup>th</sup> day for this trait.

Higher browning index in the fiber added cookies might be due to change in color of fiber during baking thus darker product compared to control. The results are consistent with those attained by Hussein *et al.* (2011). The former reported enhanced b\* values in biscuits containing higher fiber levels using flour of raw, soaked and germinated fenugreek flour blended with that of corn. It has been observed that color could not be persistent during storage, however by improving packaging and storage conditions this problem can be further minimized.

**Sensory evaluation:** Mean squares explicated that treatments and storage exerted significant effect on the sensory attributes like color, flavor, taste, texture and overall acceptability (Table 5).

**Color:** For control sample, scores assigned for color were 7.28±0.05 whereas in cookies containing psyllium husk means ranged from 7.47±0.04 to 6.14±0.09 in T<sub>1</sub>

and T<sub>5</sub>, respectively (Table 6). During storage, the scores for color slightly declined from 7.20±0.03 to 7.09±0.04 within two months (Table 7).

Color is significantly affected by the addition of psyllium husk however, replacement up to 20% is quite acceptable in cookies. The results are supported by the earlier work of Sharif *et al.* (2009), they observed significant effect of fiber on color of the cookies. Likewise, fiber addition exerted momentous effect on color is also reported by Pasha *et al.* (2011).

The color fading during storage might be due to effect of light and other physiochemical changes that occurred due to increase in moisture and fat oxidation and the phenomena is strengthened by the work of Manley (2002).

**Flavor:** Scores for flavor elucidated that husk addition in dietetic cookies imparted positive effect (Table 6). Means for T<sub>0</sub> were 7.08±0.08 compared to T<sub>1</sub> as 7.32±0.11 whereas, scores for T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were 7.23±0.09, 7.20±0.08, 7.21±0.08, respectively thus behaved non-significantly. However, T<sub>5</sub> attained the lowest scores of 5.80±0.19. Regarding storage, the highest scores for flavor were at 0 and 15 days that differed non-significantly with the values of 7.21±0.03 and 7.16±0.03, respectively. Nevertheless, the minimum scores 6.77±0.04 were recorded after two months (Table 7).

Flavor is the perception influenced by taste and smell impression even the appearance and texture may also affect this attribute (Manley, 2002). Treatments showing significant effect on flavor might be due to psyllium husk supplementation in the cookies as imparts its own hedonic acuity. Similar trend was reported by Nassar *et al.* (2008) that biscuits containing 5 and 10% peel and pulp had highest acceptability compared to control. Changes in flavor sensation during storage of cookies could be due to fat oxidation that triggered by moisture absorption. Similar pattern of flavor loss during storage was recorded by Sharif *et al.* (2009).

Table 5: Mean squares for sensory evaluation in dietetic cookies

SOV	df	Color	Flavor	Taste	Texture	Overall acceptability
Treatments (A)	5	3.526**	5.031**	2.491**	5.441**	5.498**
Storage (B)	4	0.063*	0.688**	0.891**	1.729**	1.143**
A*B	20	0.016 <sup>NS</sup>	0.153*	0.078**	0.435**	0.013 <sup>NS</sup>
Error	60	0.018	0.007	0.023	0.030	0.027
Total	89					

NS = Non-significant; \* = Significant; \*\* = Highly significant

Table 6: Effect of treatments on sensory attributes of dietetic cookies

Treatments	Color	Flavor	Taste	Texture	Overall acceptability
T <sub>0</sub>	7.28±0.05b	7.08±0.08b	7.09±0.06b	6.05±0.24d	6.19±0.13b
T <sub>1</sub>	7.47±0.04a	7.32±0.11a	8.00±0.14a	6.21±0.16c	7.53±0.14a
T <sub>2</sub>	7.30±0.12b	7.23±0.09a	7.58±0.15a	6.45±0.12b	7.52±0.11a
T <sub>3</sub>	7.28±0.12b	7.20±0.08a	7.53±0.14a	7.46±0.10a	7.42±0.13a
T <sub>4</sub>	7.22±0.06b	7.21±0.08a	7.52±0.11a	7.18±0.08a	7.38±0.12a
T <sub>5</sub>	6.14±0.09c	5.80±0.19c	6.84±0.15c	6.07±0.18d	6.41±0.14b

Mean values carrying same letters in a column are not significantly different. T<sub>0</sub> = Control; T<sub>1</sub> = 5% of psyllium husk; T<sub>2</sub> = 10% of psyllium husk; T<sub>3</sub> = 15% of psyllium husk; T<sub>4</sub> = 20% of psyllium husk; T<sub>5</sub> = 25% of psyllium husk

Table 7: Effect of storage on sensory attributes of dietetic cookies

Storage (Days)	Color	Flavor	Taste	Texture	Overall acceptability
0	7.20±0.03a	7.21±0.03a	7.74±0.03a	6.86±0.04a	7.34±0.04a
15	7.15±0.03ab	7.16±0.03a	7.50±0.03b	6.68±0.04b	7.22±0.04ab
30	7.08±0.03b	6.90±0.04b	7.46±0.03b	6.68±0.03b	7.17±0.04b
45	7.05±0.03b	6.84±0.04b	7.26±0.03c	6.66±0.04b	6.95±0.04c
60	7.09±0.04b	6.77±0.04c	7.17±0.03c	6.05±0.05c	6.71±0.04d

Mean values carrying same letters in a column are not significantly different

**Taste:** Regarding taste, treatments showed varied response (Table 6). The highest scores were assigned to T<sub>1</sub> and T<sub>2</sub> i.e. 8.00±0.14 and 7.58±0.15, respectively as compared to 7.09±0.06 in control. Nevertheless, T<sub>5</sub> got the lowest score 6.84±0.15. Effect of storage provided a range for this trait from 7.74±0.03 to 7.17±0.03 at 0 and 60 days, respectively (Table 7).

Scores for taste of cookies varied from 8.00±0.14 to 6.84±0.15 however, treatments T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were statistically at par with means scores 7.58±0.15, 7.53±0.14 and 7.52±0.11 correspondingly. Taste is also affected by texture and composition of the product and in the present case cookies rheology and composition were altered due to husk addition.

It is interesting to mention that 20% replacement of flour with psyllium husk had better taste and acceptability. The results are in agreement with the findings of Nassar *et al.* (2008) and Sharif *et al.* (2009). Decrease in taste scores during storage may be due to absorption of moisture that consequently triggers oxidative and hydrolytic deterioration in cookies thus leading to decline in hedonic response (Sharif *et al.*, 2009).

**Texture:** For texture, the highest scores 7.46±0.10 were observed in T<sub>3</sub> followed by 7.18±0.08, 6.45±0.12, 6.21±0.16 and 6.07±0.18 in T<sub>4</sub>, T<sub>2</sub>, T<sub>1</sub> and T<sub>5</sub>, respectively, whilst the lowest scores 6.05±0.24 were assigned to T<sub>0</sub> (Table 6). Results concerning storage revealed diminishing trend; fresh cookies attained the highest scores 6.86±0.04 while the lowest 6.05±0.05 were recorded at 60<sup>th</sup> day (Table 7). Psyllium husk addition showed suitability up to 20% afterwards a sudden decline in texture was observed.

Earlier, Nassar *et al.* (2008) reported similar pattern in peel fiber added cookies. Likewise, momentous effect of fiber addition on texture of cookies by adding defatted rice bran was expounded by Sharif *et al.* (2009).

During storage, deterioration in quality is possibly owing to moisture absorption in cookies from the surroundings. Moreover, psyllium husk has tendency to absorb moisture readily therefore in the resultant cookies increased moisture content. It has already been proved that increased moisture has inverse association with texture thus decreased scores. Similar results regarding texture were reported by Pasha *et al.* (2002) using dietetic sweeteners in cookies. Moreover, Piga *et al.* (2005) evaluated cookies during storage and proposed the similar mechanism regarding textural changes.

**Overall acceptability:** Treatments exerted significant effect on the overall acceptability of cookies. The highest scores were attained by T<sub>1</sub> as 7.53±0.14 that statistically at par with T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> with scores as 7.52±0.11, 7.42±0.13 and 7.38±0.12 respectively, whereas the lowest scores 6.19±0.13 were recorded for control (Table 6). The panel ranked fresh cookies at the highest position by assigning scores of 7.34±0.04 while the lowest 6.71±0.04 were awarded at completion of study (Table 7).

Hedonic response regarding overall acceptability revealed that addition of psyllium husk played a positive role along with appraising color, flavor and taste scores. Storage exhibited declining trend and minimum scores were assigned at 60<sup>th</sup> day. The results are in harmony with those noted earlier (Pasha *et al.*, 2002; Butt *et al.*, 2004; Sharif *et al.*, 2009; Nassar *et al.*, 2008). Considering the results of sensory view point, it is concluded that psyllium husk addition up to 20% in cookies is quite acceptable, providing sufficient amount of dietary fiber and has potential to be used as dietary intervention against life-style related disorders.

In conclusion, color tonality and sensory response of psyllium based cookies showed significant variations. The L\* value of the cookies decreased with the addition of psyllium husk while a\* and b\* values were increased. However, storage of 60 days of the dietetic cookies showed significant increase in L\* value whilst a\* and b\* values were decreased. Sensory response like color, flavor, taste, texture and overall acceptability of the psyllium husk addition of 10, 15, 20% in cookies revealed statistically at par results except for texture. It is therefore suggested that psyllium based cookies up to 20% are acceptable that may help to fulfill the daily dietary fiber requirement.

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