The Effect of Fenugreek Gum on The Rheological and Qualitative Properties of Pan Bread

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Abstract. This research was conducted to investigate the effects of adding levels of Fenugreek seeds gum 0.5-2% on the qualitative and rheological properties of wheat flour (70% extraction). The results of the chemical composition of wheat flour and flour contain fenugreek gum showed that there is an increase in moisture content, protein, fat, ash and carbohydrate as the level of fenugreek gum replacement was increased. Ratios of wet gluten, dry gluten, gluten index and colour in wheat flour contain fenugreek gum was found to be significantly higher (P ≤ 0.05) compared with the control. The rheological properties of flour prepared with an adding of fenugreek seeds gum were estimated. The adding of fenugreek gum caused changes in the rheological properties of dough. The adding of fenugreek gum to the dough led to increased water absorption and dough stability. However, the development time, degree of softening and farinograph quality number were decreased. The sensory evaluation of loaf for different treatments showed better acceptability for the blend flour in comparison with the control. However, it can be recommended that the panelists preferred 2% of Fenugreek seeds gum replacement.

1. Introduction

Bread is a product consumed worldwide with a high nutritional value, hydrocolloids have specifically used a wide application as additives in bread formulations [5, 7, 17]. Traditionally, bread prepared from wheat but use of other flours such as fenugreek, pea, spelt, rye, soybean, buckwheat, rice, barley moringa seed, oat flour and chestnut [15]. These additives are added to improve its sensory and nutritive [10]. The dough rheological is improve due to hydrocolloids addition and keeping qualities of ended baked products. There are several studies showing [18]. The influence of fenugreek gum and extrusion modified fenugreek gum on the rheological properties of dough who indicate the water absorption increase with increase addition of fenugreek. studied the use salep gum and Persian gum for improving the fresh bread quality attributes of final product. Fenugreek gum a galactomannan type which is extracted from the endosperm of seeds. FG is consist of mainly of galactomannan has a great content of galactose, which makes FG very soluble in water, and able to produce highly viscous solution. The potential fenugreek seeds gum could be significant for the food industry like baking, bread manufacture, gravies, soups, chocolate and ice cream [19, 9, 6, 13].

The aim of this research was to examine the chemical, rheological and processing properties of wheat flour (70% extraction) which supplanted by 0.5%, 0.75%, 1% 1.5% and 2% fenugreek gum.

2. Material and Methods

2.1. The seeds were purchased from the local market of Basrah city. The seeds were grinding using a coffee grinder. Wheat flour (70% extraction) was obtained from Farahidi mill/ General company for grain processing/ Basrah, and other materials were purchased from market local such a sugar, dry yeast, fat and salt. All the other solvent reagents and chemical used were analytical grade.

2.2. Extraction of gum

The gum was extracted according to the method described by [11]. The fenugreek powder was soaked in distilled water within a ratio (1:10 w/v), then kept under shaking for 4h at 40 C°. The viscous solution was filtered through muslin to remove the fibers. Ethanol (99%) was added in the ratio 1:1 to precipitate out the gum present. The gum was dried in oven at temperature 40-45 C°. The dried gum was stored in airtight container.
2.3. Mixing
Fenugreek seeds gum was added at different levels 0.5 -2% to wheat flour to produce pan bread , using wheat flour with 0% fenugreek seeds gum was considered as control for all analyses; The control treatment had no fenugreek seed gum added.

2.4. Chemical Analysis for flour
2.4.1. Moisture, protein and ash were determined using Inframatic Device
2.4.2. Fat was determined according to [2].
2.4.3. Total carbohydrate was calculated according to [12]
2.4.4. Wet and dry Gluten Determination and Gluten Index.
Wet gluten and Gluten Index were determined using Glutamic 220 System.
Dry gluten was calculated using Equation
\[
\text{Dry gluten\%} = \frac{\text{Wet gluten}}{2}
\]

2.4.5. Color.
Thirty grams of wheat flour containing gum were weighted and mixed with 50 ml of distilled water. The suspension was placed in cell and the color was measured using Color grader series lv (Ocrim. Germany).

2.5. Flour strength tests.
Pelshenke and Zeleny tests were procedure according to [1]

2.6. Farinograph Test.
The rheological properties of wheat flour dough were tested with the addition of fenugreek seed gum at a ratio of (0.5-2%) by Farinograph (Brabender. Germany). The dough water absorption, dough Development Time, Degree of Softening and Farinograph quality number were determined.

2.7. Bread manufacture.
Bread was prepared from flour by using straight dough method No. 10-10 in method described in [1]

Table 1. Formulation of bread

| The Ingredients | Wheat flour | Fenugreek gum | Water | Sugar | Fat | Dry yeast | Salt |
|----------------|-------------|----------------|-------|-------|-----|-----------|------|
| Amount in gram | 100         | 0.5-2%         | 60%   | 1     | 3   | 1.5       |

The Ingredients were mixed. The yeast was prepared with water and added in dough mixer by keeping the mixer at 1 speed. The quantity of water used for the control and FG bread was based on the farinograph absorption. The mixing was done after addition fat 1 and salt 1.5 and water was added. after mixing, the dough was placed in proofing cabinet at 30-32 C and 80-85% relative humidity for 45 min. After punching the dough was divided and again proofed for 10 min under the same conditions. Finally the dough balls were sheeted and placed in proofing cabinet for final proofing for 60 min under the same conditions. The loaves were baked for 45 min at 180 C, after baking the loaves were cooled at room temperature. The loaves were weighted after a cooling. The loaves volumes of the bread samples were measured by the seed displacement in method described in [1]. Specific volumes were calculated by dividing the loaf volume by the loaf weight, and expressed in cm$^3$/ml.

2.8. Sensory evaluation.
All sample were evaluated by ten panelists from. Food Science, Collage of Agriculture, University of Basrah. Quality score for pan bread included volume (10), color of the crust (8), the crust characteristic (3), Bake characteristic (3), Symmetry commission (3), Cutting line and spreading (3), Grain of crumb (10), Crumb colour (10), Taste (15), Chewing (10), Texture (15). The procedure was carried out by [3].

2.9. Statistical Analysis
All the chemical data and rheological properties analyses were made 3 replications except the sensory test that was performed in 10 replications. These data were analyzed using SPSS 2012. The comparative analysis between parameters was carried out using L.S.D. with probability (P ≤ 0.05).
3. Results and Discussion.

Table 2 showed the addition of fenugreek gum led to increase in moisture while the control had the lowest moisture (p ≤ 0.05) increased moisture observed at flour samples gum containing due to high water holding capacity of gum. The results agree with findings [20] who showed that moisture content was increased with salep gum and Persian gum addition.

The results showed in Table 2 ash content of samples was increased by gum addition. These results are in agreement with those of [10] who showed that gum addition caused an increase in ash content. Gum adding lead to increase of protein content, fat and carbohydrate of gum-containing flour compared with wheat flour because fenugreek gum contain protein, fat and carbohydrate. The results was inagreement with by done by [8] who showed that the addition gum bera led to an increase in moisture content.

The effects of addition fenugreek seeds gum on the colour of wheat flour was showed in Table 2. the result indicate that adding gum leads to an increase in the colour with the control. As the highest colour value reached at 2% concentration, and this was due to the presence of pigments in the gum such as carotein.

The results in Table 2 also showed that the adding fenugreek gum led to an increase in the values of wet gluten for the flour samples containing gum from 25 to 36%, the gluten index 80 to 98% compared with the control. The gluten index gave an idea of the quantity and quality of protein. It may be defined as the ratio of high fractional weight proteins over low fractional weight weight protein [7]. The gluten index and the zeleny tests gave an idea of the gluten quality in the flour [14].

3.1. Influence of the addition fenugreek seeds gum on flour strength.

The results in Table 3 indicated that the values of the pelshenke and zeleny test were higher in the sample containing gum compared with the control. The pelshenke test value increased from 62 min for the control to 80 min for sample containing at concentration 2% fenugreek seeds gum. The ability of the flour to retain gas was affected by the quantity and quality of gluten, good gluten takes time longer than the weak gluten.

| Tests          | Control | 0.5% | 0.75% | 1%  | 1.5% | 2%  | L.S.D |
|----------------|---------|------|-------|-----|------|-----|-------|
| Pelshenke      | 62      | 66   | 67    | 70  | 77   | 80  | 1.80  |
| Zeleny         | 25      | 47   | 50    | 52  | 55   | 60  | 1.90  |

while the value of the zeleny test increased from 25ml for the control to 60 ml for the sample flour at concentration 2% fenugreek gum.

3.2. Influence addition fenugreek seeds gum on rheological properties of dough wheat flour.

The effect of fenugreek gum addition on rheological properties of wheat flour showed in Table 4 and figure 1, the result showed that the addition fenugreek seeds gum at concentrations between 0.5- 2% resulted an increase in the water absorption from was 61.2% for control which gradually increased
from 62% for 1% fenugreek seeds gum. The increase was due to the hydroxyl group in gum structure [10]. The water absorption was an important property that was not affected by the consistency of the dough only, but rather led to produce an economical product by allowing water to link through hydrogen bonds[18].

Table 4. Effect the addition fenugreek seeds gum on rheological properties of dough wheat flour

| Parameters                  | Control | 0.5% | 0.75% | 1%   | 1%   | 1.5% | 2%  | L.S.D |
|-----------------------------|---------|------|-------|------|------|------|-----|-------|
| Water absorption            | 61.2    | 61.6 | 61.7  | 62   | 61.6 | 61.5 | 1.0 |       |
| Development time            | 2       | 1.7  | 1.9   | 1.5  | 1.5  | 1.8  | 0.1 |       |
| Stability                   | 8       | 8.7  | 8     | 8.1  | 9.3  | 9.4  | 0.1 |       |
| Degree of softening         | 43      | 52   | 61    | 66   | 39   | 21   | 1.0 |       |
| Farinograph quality number  | 34      | 28   | 26    | 26   | 28   | 28   | 1.0 |       |

The stability of the control was 8 which gradually increased to 9.4min at concentration of 2% fenugreek seeds gum. The increase in the stability value was attributed to the formation of gum complex with gluten by forming hydrogen bonds [7]. Addition of gum at concentration of 2% decrease development time, degree of softening and Farinograph quality number compared with the control. The result showed the positive effect of adding fenugreek gum on the rheological properties and the gluten network. Results was in agreement with reported by [19] who indicated that the addition Persian gum led to a decrease in development time.

3.3. Influence addition fenugreek seeds gum on volume, weight and specific volume
The results in Table 4 was observed that by increasing the fenugreek seeds gum, bread volume was increased as compared to the control, the specific volume was increased from 2.22 ml/g for the control to 3ml/g at concentration of 2% of fenugreek gum. However, the volume of bread depended on type of the gum used and the level of substitution. This difference in the bread volume had an effect on the specific volume of the bread. Therefore, adding fenugreek gum improved specific volume of the bread. This result was in agreement with finding [18] who indicated that adding fenugreek gum increased bread volume and specific volume. The baking parameters of dough depend on the quality and quantity of gluten [7] the results were in agreement with his findings of a study done by[8] showed that adding bera gum to flour led to increase in specific volume.

3.4. Influence addition fenugreek seeds gum on sensory evaluation.
The results for sensory evaluation of pan bread were presented in Table 5 According the bread containing fenugreek gum received scores higher than the control. Addition fenugreek gum led to an improvement in the colour of bread crust, which was attributed to maillard reaction and the other reason was due to the presence of yellow pigment presence in the gum. The results were not agreement with reported by [10] who indicated that the adding cordia gum to the bread led to an increase in darkness.
Figure 1. Effect of fenugreek gum on farinography properties of wheat flour dough. 
a: control, b: wheat flour contain 0.5% fenugreek gum, c: wheat flour contain 0.75% fenugreek gum, d: wheat flour contain 1% fenugreek gum, 
e: wheat flour contain 1.5% fenugreek gum, h: wheat flour contain 2% fenugreek gum

Table 5. Effect addition fenugreek gum on quality characteristics of pan bread.

| Quality characteristics | Control | 0.5% | 0.75% | 1%  | 1.5%  | 1.5%  |
|-------------------------|---------|------|-------|-----|-------|-------|
| Weight                  | 148.2   | 155  | 157   | 158 | 160   | 163   |
| Volume                  | 330     | 450  | 460   | 470 | 480   | 490   |
| Specific volume         | 2.22    | 2.89 | 2.92  | 2.97| 2.98  | 3     |

Table 6. Effect addition fenugreek gum on Sensory evaluation.

| Bread sensory components | 0% | 0.5% | 0.75% | 1% | 1% | 1.5% | 1.5% |
|--------------------------|----|------|-------|----|----|------|------|
| Stability External       |    |      |       |    | L.S.D|
| characteristics          |    |      |       |    |     |      |      |
| Volume                   | 7.2| 8.5  | 8.6   | 8.6| 9.22| 0.62 |
| Colour of crust          | 7.4| 7.2  | 7.5   | 7.6| 7.8 | 0.34 |
| Crust character          |    |      |       |    |     |      |      |
| Symmetry commission      | 2  | 2.3  | 2.4   | 2.6| 2.6 | 1.18 |
| Degree of softening      | 1.6| 2.4  | 2.3   | 2.7| 2.8 | 0.37 |
| Bake characteristic       |    |      |       |    |     |      |      |
| Cutting line and speeding| 1.8| 2.4  | 2.5   | 2.7|     | 5.33 |
| Internal characteristics  |    |      |       |    |     | 3    |
| Grain | 2   | 2.9 |
|-------|-----|-----|
| Crumb colour | 2.7 | 2.8 |
| Flavor | 8.7 | 8.99 |
| Taste | 8.22 | 8.87 |
| Chewing | 8.21 | 8.89 |
| Texture | 8.25 | 0.48 |
| Flavor | 8 | 8.5 |
| Taste | 8.6 | 8 |
| Chewing | 8.21 | 8.1 |
| Texture | 8.22 | 11.9 |
| Flavor | 8 | 8.11 |
| Taste | 9.33 | 8.65 |
| Chewing | 9.22 | 14 |
| Texture | 8.25 | 10 |
| Flavor | 10 | 11 |
| Taste | 11.8 | 14 |
| Chewing | 12 | 15 |
| Texture | 14 | 1.0 |
| Flavor | 10.5 | 12 |
| Taste | 13 | 9.1 |
| Chewing | 14.4 | 9.11 |
| Texture | 1 | 1.52 |
| Flavor | 3 | 0.16 |
| Taste | 0.5 | 0.48 |
| Chewing | 1.0 | 1.0 |
| Texture | 1.52 | 1.17 |
| Flavor | 1 | 0.5 % |
| Taste | 0.75 % | 0.21 |
| Chewing | 1.0 | 12 |
| Texture | 1.5 | 14 |
| Flavor | 2 | 0.16 |
| Taste | 0.5% | 0.48 |
| Chewing | 1.0 | 1.0 |
| Texture | 1.52 | 1.17 |

After adding gum, all external characteristics improved such as volume, symmetry commission, crust character, bake characteristic and cutting line and speeding of bread containing. The highest was observed at a concentration of 2% fenugreek gum.

The results in Table 5 showed that the control sample obtained the lowest scores for the taste, texture, flavor compared with bread containing fenugreek gum. Grain, Flavor, Taste, Chewing, Texture were significantly affected (P ≤ 0.05) by increasing replacement.

The results Sensory evaluation showed that bread containing gum had the highest scores compared with the control, the results indicated that the gum-added bread at a concentration of 2% was preferred by the panelists.
4. Conclusions
The study showed that the addition of fenugreek seeds gum led to an increase in moisture content, protein and carbohydrate. wet gluten, dry gluten, gluten index and colour compared the control. The results showed the addition of gum improved the rheological properties of wheat flour. addition of gum at a concentration of 2% positively influenced on the rheological properties. This could be seen by the high water absorption and dough stability and lower degree of softening, while low in the development time and Farinograph quality number as compared to the control. The results indicated a concentration of 2% fenugreek seeds gum to produce pan bread of high sensory acceptance and effect positive organoleptic properties.

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