Effects Wheat Gluten on The Physicochemical and Sensory Properties of Local Burger

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Abstract

This study includes the production of beef substitute from wheat gluten and its introduction into the manufacture of beef Burger, the properties and sensory evaluation were tested, as the functional properties of gluten were tested. When estimating the water absorption capacity, the gluten recorded the highest water absorption at pH 7, where the water absorption amount reached 2.69 ml/g gluten. The susceptibility to binding of fat was 1.5 g oil/g of gluten, as the chemical nature of the ability to bind to the lipid molecules. As for the sensory evaluation, it included the treatment A of gluten with saline solution %3 NaCl and treatment B Solution 4% apple vinegar and treatment C 15% soaking tamarind. The treated gluten with saline solution %3 NaCl scored the highest total sensory evaluation of 78.7%, and as for the treatment of gluten with a solution 4% apple vinegar recorded the lowest sensory evaluation rate of 58.8%, and treatment C 61.9 % that all of the gluten treatment included the boiling of the gluten with the above solutions for 10 minutes, separately. The results of the microbial analysis referred to possibility of well-protected burger for 4 days in a refrigerator after preparation, where the microbial contamination is within the allowed limits for human consumption.

Keywords: Wheat gluten, Apple vinegar, Local burger.

1. Introduction

The world recently was witnessing health nutritional risks arising from several causes; the most important are diseases of high blood pressure, vascular problems, and cholesterol, which was one of the causes from excessive eating of meat. The study also indicated that vegetarians have the advantage of being less infected with these diseases compared to people who eat meat regularly, as well as less death at an early age among vegetarians [1].

Also, some studies have shown the high incidence of cardiovascular diseases in people who eat meat regularly compared to vegetarians according to what he mentioned [2]. In addition to these health risks, one of the most important goals of nutritional is to obtained a high-quality food product and low cost as it mixes plant protein and animal protein improves the performance of the food product. Wheat is an energy source in most countries of the world, and gluten of wheat is an important protein because of its distinctive nutritional properties, which made it at the forefront of proteins used in preparing alternative foods of nutritional and therapeutic value [3]. Gluten is used in preparing many food dishes because it is a protein with a fleshy tissue similar to meat [4]. Burger is one of the most important manufactured meat products and the most common and receptive, whether at the country or global level [3], for this it is necessary to develop the qualitative and sensory characteristics of processed meat burger and reduce the cost of producing this product [5]. Many studies and researches have indicated the possibility of using different proportions of carbohydrates (filling) in making burger [6]. Oatmeal was used when making burger tablets using beef, They noticed an increase in freshness by increasing the percentage of addition as well as improving its qualitative characteristics. The study [7], included the effect of adding different proportions of filling materials such as rice flour and boiled potato dough as a partial alternative to meat when making burger tablets. Taste sensory characteristics increased, freshness and general acceptance with reduced protein content.

2. Materials and Methods

2.1 Prepare vital wheat gluten

The standard method (10-38) [8], for obtaining wet gluten was used by mixing the flour with water and forming a relatively hard dough ball, then quietly washed under the tap water until a reached to brown rubber mass is the gluten, then was kept in a container of polyethylene bags in the refrigerator (4 ±2) °C until use.
2.2 Determination of flour and gluten ingredients

- Determination of humidity: The percentage of humidity was estimated using the standard method of the American Grain Chemistry Association No. (19-44) [8].
- Estimate the percentage of protein: The nitrogen ratio was estimated using the standard Kildal method No. (12-46), [8] and multiplying the result by a factor of 5.7 to obtain the proportion of protein.
- Ash rate estimate: Ashes were estimated according to the standard method number (0.8 - 0.1) [8]
- Estimate the percentage of fat: The fat percentage was estimated using the Soxhlet device According to the standard method approved by a chemical association American Oils No (44-3) [9] Using ethyl ether.
- Estimate the percentage of carbohydrates: The percentage of carbohydrates was calculated by the difference after adding the percentage of protein, ash, fat and moisture and subtracting it from 100%. The difference represents the percentage of carbohydrates.

2.3 Estimating the functional properties of gluten

- Estimate water absorption: The method [10] was used by mixing 1 g of a gluten sample with 10 ml distilled water for 30 seconds, and the sample was left at the laboratory temperature for 30 minutes, then separated by centrifugation at a speed of 1500 cycles / minute for 30 minutes, then according to the volume of the suspension received in a graduated cylinder to find the volume of absorbed water ml/1g sample at values pH (5, 6.8, 7, 8, 9).
- Fat binding determination: 1g of gluten sample was mixed with 10 ml Sunflower oil (Turkish Etant brand, prepared from the local market) and the sample was left at the laboratory temperature for 30 minutes after which the central centrifugation was performed at a speed of 1500 rpm for 15 minutes, and according to the volume of the associated oil ml/g sample by reception suspension in A cylinder according to the method mentioned by [10].
- Treatment of gluten: Gluten extracted from wheat flour (Zear) was used and then boiled with salt water at 3% NaCl for 10 minutes and it was considered the first treatment (A). A second treatment was included boiling the pieces of gluten with a solution 4% apple vinegar for 10 minutes (B). A third treatment was included boiling gluten with a soaking tamarind 15% for 10 minutes (C).
- Beef Burger industry: The mixture below was used to prepare samples of Beef Burger from the treated gluten by the previous treatments, separately according to the standard recipe mentioned by [11], which consists of 100g gluten, salt 10 g, black pepper 10 g, kababah 5g and ground beef lean minced 150 g. The mixing of the ingredients was done manually and then passed through a meat mincing machine Japanese-made for mixing the ingredients well, then the forming process to cut the burger at 60 g. The weight of the piece was formed by a manual prepared for the purpose of forming the burger tablets. The cooking process was carried out in a Gas stove (Brand i-chef Egyptian-made) at a temperature of 180°C for 20 minutes.
- Sensory evaluation of beef burger: The sensory evaluation process was performed according to the evaluation form below [12] by ten experienced evaluators in the laboratories of the Ministry of Science and Technology, Food Pollution Research Center in Baghdad.

| Quality elements | Color | Regularity of The highest shape | Texture | Smell and taste | Chewing |
|------------------|-------|-------------------------------|---------|----------------|---------|
| Degree limits %  |       |                               |         |                |         |
| 25 Excellent     | 20 very good 15 medium 10 acceptable 5 rejected | 20 excellent 16 good 12 medium 8 acceptable 4 Denied | 20 excellent 16 good 12 medium 8 acceptable 4 Denied | 25 Excellent 20 good 15 medium 10 acceptable 5 rejected | 10 Excellent 8 Very Good 6 Medium 4 rejected |
| Scale            | Highest brownish brown | score for a moderate edge tablets | Non-elastic grip | Smell and taste similar to meat | Easy to cut and chew in the mouth |

2.4 Statistical Analysis

The data were statistically analyzed by the experimental system in the statistical program [22], and using CRD means were selected according to the Duncan multi range test [23]. To determine the significant differences between the mean factors affecting the traits studied at (0.05) and variance $\sigma^2e$.
3. Results and Discussions

It appears from Table (2) the results of the chemical analysis of the Turkish flour brand Zear and the gluten extracted from it. We note that the moisture content in the flour is 11.40% and it is considered a high percentage as the moisture content is important in determining the quality of the flour, while the moisture content of the gluten has reached 5.5%. It is considered a low percentage, according to [13]. The protein content in flour was 13.15%, similar to what Macretchie found [14] for a good flour protein, where protein is an important criterion for flour quality [15]. As for the gluten, the protein ratio was 74.1%. The fat percentage for flour reached 1.52% and for gluten 1.5%. The higher percentage of fat in the gluten compared to flour is due to the ability of the gluten to bind the fat depending on the size and distribution of the particles. The ash content in flour is 0.49% and in gluten 0.35%, and these results are close to what it came with [16] when he studying the chemical, physical, and biological properties of wheat flour for two local cultivars (mesipak and saberbeek) that the percentage of ash 0.52%, and the results came close to what he found [17] that The percentage of carbohydrates rises in flour and decreases significantly in the gluten, as it recorded 75.4% and 13.5% for each of the flour and gluten, respectively.

We note from Table (3) That the ability to bind to water increased compared to the normal pH 6.8 where the reason is that when the susceptibility of proteins to bind to water is due to the increase in the surface activity that detects water (Hydrophobic activity). At pH 7, the surface activity that detects water decreases from what it makes them more hydrophilic. Increasing the ability of proteins to dissolve in water, and this is consistent with Fernanda and Caroline [18] when they estimate the susceptibility of wheat gluten prepared in the laboratory to absorb the water appeared to be between 2.40-2.33 ml water/g of gluten, according to their findings.

Fat binding: It is obvious that the volume of the fat associated with wheat gluten reached 1.5 ml oil/g gluten. The mechanism of fat binding is due to the physical properties of fat, as fat is associated with the non-polar groups of protein molecules through the two type of protein (gloutenin and gelydine) simultaneously. The simultaneous association of fats with gloutenin and gelydine can contribute to the construction of complexes in the gluten that increase elasticity [19,20].

| Subject       | Humidity % | Protein% | Fat% | Ash% | Carbohydrates % |
|---------------|------------|----------|------|------|-----------------|
| Flour (Zear)  | 11.4       | 13.15    | 1.52 | 0.49 | 75.4            |
| Gluten (Zear)| 5.5        | 74.1     | 1.5  | 0.35 | 13.5            |

Table 3. Volume of absorbed water (mL/g gluten) for wheat gluten at pH values

| pH | Volume of absorbed water (mL/g gluten) |
|----|---------------------------------------|
| 5  | 2.31                                  |
| 6.8| 2.6                                  |
| 7  | 2.69                                  |
| 8  | 2.45                                  |
| 9  | 2.39                                  |

Table (4) shows the characteristics of the product made from the gluten, that there are significant differences (p<0.05) between the rates sensory evaluation, Where the treatment A (solution 3% NaCl) was recorded the highest total sensory evaluation where it was 78.7%, and the treatment B is the (apple vinegar solution 4%) 58.8%, and third treatment C (Soaking tamarind 15%) 61.9 %, thus we notice that the first treatment is the best treatment because it gave the highest sensory evaluation points. Color characteristic recorded 17.5, 11.5 and 12 for the treatments, respectively. As for the regularity of the shape, the first treatment recorded the highest evaluation compared to the other treatment, and the grades according to the sequence were 15.7, 9.5 and 11.3 for the treatments. The texture attribute was 17 for the first treatment and 11.9, 17.1 for the second and third treatment. While the characteristic smell and taste was recorded in the first treatment 20.2, the second 17.7, the third 14, as for the ability to chew it was 8.3, 8.2 and 7.5 for the treatments, respectively. By doing this, we note that the first treatment was the best in the sensory evaluation of the degrees obtained.

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Table (5) it is noted from the table that all treatments are free of any microbial contamination in preparation, that because of following the health conditions during manufacturing, as well as exposure to cooking and temperature was sufficient to kill any microbial contamination can occur, but after storage of 3 days at refrigerator temperature, microbial contamination increased and was also within I remember the limits allowed for human consumption, but it was later observed increasing in microbial numbers after increasing the storage period 4-7days in the refrigerator and became unsuitable for human consumption, as laboratory-prepared beef burger cannot be stored more than 2 days, it should be given immediately after preparation for the safety of human [21].
Table 4. Burger sensory evaluation.

| Laboratory Evaluation | Color | Shape | Textures | Smell and taste | Chewing | Total |
|-----------------------|-------|-------|----------|-----------------|---------|-------|
| Treatment A           | 17.5  | 15.7  | 17       | 20.2            | 8.3     | 78.7  |
| Treatment B           | 11.5  | 9.5   | 11.9     | 17.7            | 8.2     | 58.8  |
| Treatment C           | 12    | 11.3  | 17.1     | 14              | 7.5     | 61.9  |
| LSD value             | 2.08* | 359*  | 3.04*    | 3.29*           | 1.261   | NS**  | 7.444* |

*The values indicate significant differences (p<0.05). **NS non significant differences.

Table 5. Microbial contamination of beef burger in preparation and after storage of 7 days at refrigerator temperature measured by colony formation unit CFU.

| Treatment | Preparing time (Zero) | 2 days | 3 days | 4 days | 5-7 days |
|-----------|-----------------------|--------|--------|--------|----------|
| A         | 2                     | 60     | 182    | 25000  | TNTC*    |
| B         | 0                     | 56     | 298    | 28800  | TNTC     |
| C         | 1                     | 79     | 367    | 24400  | TNTC     |

*TNTC = to numerous to count

Conclusion

It is obviously that:
- Boiling the gluten in 3% saline solution gave good results in taste and acceptability of burger.
- The gluten recorded the highest water absorption at pH 7.
- Increase the proportion of protein in the burger, it contribute to the construction of complexes protein in the gluten that increase elasticity.
- Microbial analysis showed free contamination of burger after storage 4 days in a refrigerator, allowed limits for human consumption.

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