

Determination of Gluten Level on Traditionally Treated Wheat.

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ABSTRACT

The scope of the present study was to determine the gluten level, thousand kernel weight, pH, and titrable acidity, on traditionally treated wheat. The results depicts that increased pH, titrable acidity, significantly decreased thousand kernel weight reduced the gluten level in 24 hr sprouting (20.08 g). In 12hr soaking (37.4 g) and 12 hr sprouting (36.48 g) treatment gluten level increases when compared with raw wheat gluten (27.52 g), where parboiled, fried, soaked + parboiled wheat has no gluten network ball get isolated. In conclusion study point out that germination increased the gluten level and prolonged increases in sprouting time reduced the gluten protein.

Keywords: Food intolerant, wheat treatment, Sprouting, Parboiling, Frying, Soaking, Gluten.

I. INTRODUCTION

Gluten is a group of immunomodulatory heterogeneous protein [1], rich in gliadin and glutenins complex with proline (10%), glycine (20%) and glutamine (35%) [2]. Gluten ball is gradually obtained during concomitant kneading of bread dough under tap water [3]. The network structure of gluten is co-established by disulphide bonds, hydrogen bonds, and hydrophobic interactions that contribute to dough formation and structure [2]. The quantity and quality of gluten proteins are determined by the elasticity and extensibility of wheat dough [4]. Intolerance to wheat gluten promotes gluten related disorders [5] and type 1 diabetes mellitus where gluten free diets prevents the autoimmune diabetes, improves insulin secretion and reduces insulinitis [6]. Wheat gluten reduces the threshold of immune response by causing maturation of antigen presenting cells by attracting leukocytes and accelerating their reactivity [7]. Recently progress in inclusion of alternative gluten free bread, oat and wheat starch based foods is increasing constantly [8], mainly due to the rising diagnosis of celiac disease [9]. In turn by following traditional processing methods like fermentation, biopreservation of wheat improves food quality, shelf life, by removing toxic, less allergenic or antinutritional factors due to lactic acid produced by lactic acid bacteria is responsible for antifungal activity due to the pH decrease [9, 10]. Germinated cereals degrade protein by proteases in fermentation medium that may develop gluten intolerance individuals [10]. The objective of this study is to determine the gluten level, relative parameters like thousand kernel weight pH, titrable acidity on traditionally processed wheat groups like raw wheat, 20 min fried, 20 min parboiled, 12 hr soaked, 12 hr soaked +20 min parboiled, 12hr soaked + 12 hr sprouted, 12 hr soaked + 24 hr sprouted wheat. This methods of wheat treatment may reduce the gluten level can be a safe food for gluten related disorder individuals with potent nutrient content.

II. MATERIALS AND METHODS

A. Sample preparation

About 18 kg of cleaned wheat seeds (Procured at Neyveli main bazaar, Tamilnadu, India) randomly divided into seven set of two and half kilograms in each processing groups were shown below in table 1.

Table.1.Traditional wheat processing and grouping

Groups	Wheat Treatment
Group 1	Raw wheat
Group 2	Parboiled wheat 20 min
Group 3	Fried wheat 20 min
Group 4	12 hours Soaked wheat
Group 5	12 hours Soaked + Parboiled wheat 20 min
Group 6	12 hours Soaked + 12 hours Sprouted wheat
Group 7	12 hours Soaked + 24 hours Sprouted wheat

B. Treatment of wheat

1. Raw Wheat: The sun dried wheat seeds cleaned and removed unwanted debris properly and stored in airtight plastic bags without any processing conditions.

2. Parboiled 20 min: The wheat sample was cooked in a pressure cooker for 20 minutes. Then the cooked wheat was rinsed with clean water and sundried for 3 days.

3. Fried 20 min: The wheat sample was fried in a hot pan until dark brown color occurred. Then the fried wheat was cooled down in the room temperature for 2 hours and then it was stored in airtight plastic container.

4. 12 hr Soaked Wheat: The wheat sample was soaked in distilled water for 12 hours. Then the wheat was rinsed with clean water and sundried for 3 days.

5. 12 hr Soaked + 20 min Parboiled: The wheat sample was soaked for 12 hours and parboiled in a pressure cooker for 20 minutes. Then the wheat samples were sundried for 3 days and stored in the airtight plastic container.

6. 12 hr soaked + 12 hr Sprouted: After 12 hr soaking wheat was spread and covered with the cotton cloth. Then it was left for 12 sprouting. Meanwhile cloth was kept wet by spraying water for every 4 hours.

7. 12 hr soaked + 24 hr Sprouted: After 12 hr soaking wheat was spread and covered with the cotton cloth. Then it was left for 24 sprouting. Meanwhile cloth was kept wet by spraying water for every 4 hours. Treated wheat samples (Fig. 1) were sundried for 3 days and stored separately in the airtight plastic container.

C. Milling

All the seven groups of sun dried wheat were milled into a fine powder and stored separately at 4 °C for further analysis.

D. Determinations

1. Determination of Thousand kernel weight according to AACC (2000) method [12]. 2. Determination of pH and titrable acidity expressed as % lactic acid on the wheat flour by Attuquayefio method (2014) [13].

3. Determination of wet gluten in wheat flour – hand washing AACC 38-10 method [2000]; About 25 g of wheat flour was taken into a bowl and made a dough ball by mixing with required amount of water. Allow the fine ball to stand in water for 20-60 min at room temperature. After soaking knead the dough ball gently under running tap water over bolting cloth or mesh sieve until all starch matter removed and the web like gluten network structure formed. It will take 20 -30 min. To conform the starch free gluten approximately, squeeze 1or 2 drops of dough wash water into a beaker containing perfectly clear water. If starch is present, cloudiness appears. Let allow the isolated gluten to stand in water for 1 hour, press the gluten ball in between the hands to dry as much as possible, weigh the moist gluten ball paced in a petriplate. Transfer to oven, maintain at 100° (24 hr), after cooling dry weight of gluten was calculated [14].

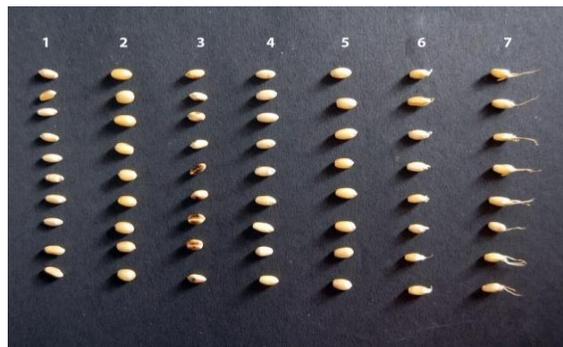


Figure1. Traditionally Treated wheat.

The numbers denotes in the figure shown above represents the groups: 1: Raw wheat. 2: Parboiled wheat 20 min. 3: Fried wheat 20 min. 4: 12 hr Soaked wheat. 5: 12 hr soaked + parboiled wheat 20 min. 6: 12hr soaked + 12 hr sprouted wheat. 7: 12 hr soaked + 24 hr sprouted wheat.

III. STATISTICAL ANALYSIS

The experiment was analyzed with three replications. The statistical analyses were done for all the data by using statistical analysis tool SPSS 17.0 with the significant of $P < 0.05$. The results were presented as mean \pm standard deviation.

IV. RESULTS AND DISCUSSIONS

A. Determination of thousand kernel weight on traditionally treated wheat.

Thousand kernel weight of parboiled wheat (52.26 g) found to be highest value while in decreasing order 12 hr soaked + 12 hr sprouted wheat (46.71 g), 12 hr soaked + 24 hr sprouted wheat (46.58 g), 12 hr soaked

wheat (45.51 g) and 12 hr soaked + 20 min parboiled wheat (45.43 g), possessing lowest value. In comparison with raw wheat (49.60 g) 20 min fried wheat (48.65 g) having highest thousand kernel weight respectively. Thousand kernel weights is an indication of kernel size and density [15]. Thousand grain weights determines seed quality that influence on germination and yield. Lowest mean of germination time increased the thousand kernel weight [16].

B. Determination of pH Values and titrable acidity on traditionally treated wheat

Table1. Shows the highest pH values obtained in 20 min fried wheat (5.53), 20 min parboiled wheat (5.42) where, lowest pH values obtained in 12hr soaked wheat (5.36) and 12 hr soaked + 20 min parboiled wheat (5.33) in comparison with raw wheat (5.40). Decrease in pH increases titrable acidity [17]. In 12 hr soaked + 12 hr germinated wheat pH values of (5.45) get increased significantly as compared with 12 hr soaked + 24 hrs sprouted wheat (5.41) respectively. Higher pH values might be due to the breakdown of fatty acids during respiration and produces organic acids like triacylglycerol, tricarboxylic acid by fermentation microorganism [18]. Lower pH values shown in sprouted seed could be due to biochemical reactions associated with substrate germination [19]. .

The highest titrable acidity was noticed in 24 hr sprouted wheat (1.89) was exacerbated by the hydrolysis of the wheat contents [20], 12 hr soaked wheat (1.45), 12 hr soaked + 12 hr sprouted wheat (1.39) in decreasing order respectively. A higher temperature formed during germination increased the production rate of lactic acid [21]. Very lowest titrable acidity was found in 20 min fried wheat (1.08), 20 min parboiled wheat (1.20), and 12 hr soaked + 20 min parboiled wheat (1.11) when compared with raw wheat (1.39). Titrable acidity, meaning a higher buffering capacity of flours. The concentration of lactic and acetic acids determines the flavor perception [22]. High acidity is responsible for low microbial load in the fermented product during the storage period [20].

Table1. Determination of Thousand Kernel weight (TKW), pH, Titrable Acidity (TA), Wet Gluten (WG) and dry gluten (DG) level On traditionally treated wheat.					
Groups	TKW (g)	pH	Titrable Acidity (%)	Gluten %	
				WG (g)	DG(g)
Group 1	49.60 ± 0.38 ^e	5.40 ± 0.02 ^c	1.39 ± 0.01 ^d	27.52 ± 0.01 ^b	10.96 ± 0.01 ^b
Group 2	52.26 ± 0.14 ^f	5.42 ± 0.00 ^d	1.20 ± 0.02 ^c	-	-
Group 3	48.65 ± 0.39 ^d	5.53 ± 0.00 ^f	1.08 ± 0.01 ^a	-	-
Group 4	45.51 ± 0.68 ^c	5.36 ± 0.01 ^b	1.45 ± 0.01 ^e	37.4 ± 0.01 ^d	13.84 ± 0.02 ^d
Group 5	45.43 ± 0.10 ^a	5.33 ± 0.00 ^a	1.11 ± 0.01 ^b	-	-
Group 6	46.71 ± 0.03 ^b	5.45 ± 0.00 ^e	1.39 ± 0.00 ^d	36.48 ± 0.01 ^c	12.16 ± 0.03 ^c
Group 7	46.58 ± 0.01 ^b	5.41 ± 0.01 ^{cd}	1.89 ± 0.01 ^f	20.08 ± 0.01 ^a	6.44 ± 0.03 ^a
The values are expressed as the mean of three replicate samples ± SD. Values with similar superscripts in a column do not differ significantly. Values with different superscripts in a column differ significantly.					
Group 1: Raw wheat; Group 2: Parboiled wheat 20 min; Group 3: Fried wheat 20 min; Group 4: Soaked wheat 12 hours; Group 5: Soaked wheat 12 hours + Parboiled 20 min; Group 6: Soaked wheat 12 hours + Sprouted 12 hours; Group 6: Soaked wheat 12 hours + Sprouted 12 hours; Group 7: Soaked wheat 12 hours + Sprouted 24 hours.					

The acidity and pH of dough are indicators of the fermentation activity of lactic acid bacteria and yeast, and determines the sensory properties of bread [23]. The pH values of the flours are highly changes in some functional properties such as solubility and emulsion [24]. Lactic acid bacteria produced during fermentation convert glucose to lactic acid significantly decreased the pH and simultaneously increased the titrable acidity of the food product [25], similarly in autoclaved food shows increased titrable acidity and decreased pH [26]. The production rate of lactic acid was higher at higher temperature [27]. The pH value of fermented food increased due to increased activity of proteolytic enzymes which hydrolyse proteins to release free aminoacids, peptides and ammonia [28].

Acidification during fermentation increases acidity and decrease the pH of wheat grain and this enhances the medical quality of food by inhibiting microbial growth [17]. Reduction in pH and a corresponding increase in titrable acidity may be due to the hydrolysis of glucose into lactic acid, ethanol and reducing sugars by microbes [29].

C. Determination of gluten level on traditionally treated wheat.

Both wet and dry gluten levels are determined on traditionally treated wheat. Gluten determines the physical properties of wheat flour dough [31]. The gluten gives strength to the bakery products. Gluten is a

very important protein because of visco-elastic properties [32]. The dry gluten fraction retains the starch and other non-glutinous matters were closely associated with protein content of wheat flours [33].

In raw wheat the gluten ball is formed by the continuous kneading of raw wheat flour [34], it contain 27.52% in wet and 10.96% in dry gluten, 12 hr sprouted wheat flour contains 36.48% in wet and 12.16% in dry gluten. Highest gluten obtained in 12 hr soaked wheat 37.4% in wet and 13.84% in dry gluten. Germination increased the protein content [35]. But in 12 hr soaked + 24 hr sprouted wheat the gluten content lowered of 20.08% in wet gluten and 6.44% in dry gluten. Increased in germination decreased the gluten content of wheat substantially by degrading the gliadin peptides into nontoxic fragments by proteases may benefits the gluten sensitives and celiac patients [36]. The gluten contains a small amount of adhering starch, is essentially hydrated proteins. Dried gluten will retain its elasticity when again mixed with water [37]. Traditional treatment methods like sprouting can reduce by break down of the harmful antinutrient gluten in wheat [38]. Thus gluten hydrolysis by fermentation yields short gluten polypeptides [1], with improved digestibility, solubility, functionality and nutritive value of grains [39]. The fermentation affects gluten quality due to protein denaturation, as it known as gluten protein affect. The reduction in stability may therefore be related to the degradation of the gluten matrix [40]. The fermentation affects gluten quality due to protein denaturation, as it known as gluten protein affect. The reduction in stability may therefore be related to the degradation of the gluten matrix [40]. These analyses of the gluten content are not presented in the parboiled, fried and 12 hours soaked + parboiled wheat flours. During boiling process, starch granules absorb water, swell and gelatinize and protein extractabilities rapidly decrease [41]. Prolonged soaking followed by parboiling reduces the level of gluten-heat sensitive toxins [39]. Gluten ball denatured and compressibility decreased by heating in boiling water bath [42]. The increase in frying temperature decreases in gluten network and deformability [43]. Wheat processing at high temperature greater than 90°C reduces gluten extractability by the exchange of sulfydral disulfide bonds between glutenins and gliadins in gluten [1]. High temperature also reduces enzyme activity and hence decrease starch hydrolysis, as high-temperature treatments will modify the characteristics of the components of the gluten matrix. Gluten matrix degradation increases with treatment intensity [40]. Compare to the treatment of wheat on gluten content in the germination will reduce the gluten content and parboiling and frying are not having the gluten content. The wet and dry gluten of treated wheat's are given in Table 1.

V. CONCLUSION

Wheat (*Triticum aestivum*) is one of a major food crops widely used for human consumption. According to this study we have determined the gluten level of traditionally treated wheat and results concludes that huge difference obtained in the amount of gluten content of the treated wheat. The present study shows that among the seven treatments the wheat flour from 20 min parboiled, 20 min fried, 12 hr soaked + 20 min parboiled wheat treatment having no gluten network content determined where, alternatively increases in the germination time absolutely 12 hr soaked + 24 hr sprouted wheat treatment reduces the gluten level with significant increase in pH values, titrable acidity and decreased thousand kernel weight when compared to 12 hr soaked + 12 hr sprouted wheat.

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