How to Cite:
Abdul, N. A., Abdulrahman, A. B. M., Mhammad, H. J., & Talb, S. S. (2022). A comparison of the physical and chemical properties of wheat and barley flour, and their products. *International Journal of Health Sciences*, *6*(S5), 3914–3924. https://doi.org/10.53730/ijhs.v6nS5.9469

A comparison of the physical and chemical properties of wheat and barley flour, and their products

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***Abstract*---**(Tiry) Bread is a type of bread produced in northern part of Iraq (Kurdistan Region), and the normal Tiry bread is produced only from wheat flour. In this research, we have used wheat flour mixed with barely flour for both flour type, and we applied several chemical tests that include (moisture, protein, Ash, and wet and dry gluten). After making the Tiry bread by the flour, we have also applied some tests (texture test, color test, starch damage, and water absorption) in quality control laboratory at Halabja Technical College of Applied Sciences, Sulaimani Polytechnic University, in 2021. In the experiment we have applied, the results showed that the highest ratio of moisture is (14.8 %), while the lowest ratio of the Ash of WFT is (0.490 %). Then, the highest wet and dry Gluten of BFT ranged between (29.63 % - 10.22 %), and the highest starch damage percentage of BFK (8.660 %), while the highest percentage for the moisture for all bread tests of BB sample is (12.130 %), and the highest value of the bread for the hardness in WB is (285 g), and the lowest hardness for BB is (85 g). The aim of this study is to show the differences between both local bread types mixed with wheat and barley flour and to compare them in both physical and chemical components.

***Keywords*---**Wheat flour, Barley flour, Tiry bread, Physicochemical, Protein, Gluten.

Introduction

The cereal crops are the most economic and social important in to the world because extensively baking industrial apply wheat flour to produce different baking products (Pagani, *et al.*, 2020). Furthermore, cereal crops comprehensively become an impact role on human life, for they contained various kind of minerals, fiber, phenolic compound, and vitamins (Awulachew, 2020). Despite, cereal crops fundamentally consist of three main parts, such as (endosperm, bran, and germ), that are used to bakery products, and they contain various kinds of nutrient (Ciudad-Mulero et al., 2021). Consequently, all cereal crops have significant roles in healthcare, especially in treating heart disease, body mass index, and diabetes (Ahmed et al., 2014).

Wheat (*Triticum aestivum* L.) is the main cereal crops cultivated in Iraq, and the second cereal crop is Barley (*Hordeum vulgare* L.). The total cultivation area is around (70 %) of wheat and (20 %) of barley. Thus, The total cultivation zone located in North side of Iraq, especially Kurdistan Region, is about 40%. Consequently, the total production in the mentioned region varies from year to year, and approximately, production of wheat and barley in a reasonable year is around (800000 tons): (50 %) of wheat and (30 %) of barley (UN Food and Agriculture Organisation, 2014).

Wheat crop is a good resource of carbohydrate, protein, fat, fiber, and ash, as well as it contains various minerals (Saeid et al., 2015). Also, Barley crop is rich of various nutrients such as soluble and insoluble dietary fiber, vitamin B complex, and several phenolic compound (Abdelazim, *et all.*, 2019). Flour of wheat quality directly affected by appearance, taste, and texture of flour, and they are related to the species of wheat, technology of processing, and storage ways (Lin et al., 2019). In addition, source of the dietary fiber in wheat crops are found in germ and bran, that are the therapies of some digesting upsets. Thus, the nutritional value in barley are related with β-gucans, and it is the main component in barley and is helpful in healthcare (Awulachew, 2020).

Generally, before human consumption, barley requires hulling, that essentially result in changing the nutrient and phytochemical profile (Irakli et al., 2020). In addition, comparing naked cultivar of barley to hulled barley, naked cultivar of barley increases nutritional value and quality food processing due to that it is related protein content, β-glucans, and soluble dietary fiber and that are free from the pales (Sterna et al., 2019). Barley is a basic raw material in production of beer, and it has essential roles in livestock feeds around European countries. Also, barley flour helps wheat flour in baking processing because it contains more fiber and less protein (Alijošius et al., 2016).

Indeed, bread is an ancient food consumed by human. However, the use of bread emerged from human beings on the earth (Hamid and Zahra, 2014). A part of Iraqi people use bread in every meal, due to the reason that it is a prat of Iraqi culture, and it is prepared by flour mixed with water and some salt, and it is also contained a vital energy (Hamdia and Salim, 2017). In Kurdistan Region of Iraq, we have many types of bread such as Tiry, Hawrami, Samoon, and Lawasha. In

this study, Tiry bread prepared with wheat flour and barley flour is used to determine the physicochemical properties and some minerals content.

Materials and Methods

This study was carried out from Kurdisan institution for strategic and scientific research, during (2021-2022) year. The experiment was applied in three local flours, and they are brought from local markets (Table 1.).

Table 1: Flour were used in this excrement

No.	Name	Kurdish Name	Resources
1	Wheat flour (Russia)	ناردی گەنم	Local Market
2	Barley flour (Ukraine)	ناردی جۆی تورکی	Local Market
3	Barley flour(Kurdish)	ناردی جۆی کوردی	Local Market

Preparation of Tiry Bread:

Tiry bread, Kurdish bread, is a common name for the widespread and old-fashioned bread in Kurdistan region of Iraq and the rest of Kurdistan in Turkey, Iran, and Syria, and it is called in the Arabic language as (Raqeq bread). Tiry bread may be similar to some other types of bread in some characteristics, but Tiry bread has distinct characteristics, such as space and the most possible thickness, by which the it is distinguished from other types of bread. Tiry bread was made in a common local way, which can be summarized in the following points:

a- The process of kneading the previously sifted flour by gradually adding warm water at the temperature of approximately (30 ° C) with continuous kneading by hand, until the dough reached the optimum state for this type of bread. Salt was added by 1.8%, and yeast was not added to the dough. Likewise, Tiry bread does not need the volume of fermentation of the dough and does not need improved materials to improve the quality characteristics.

b- The amount of water absorption to prepare the dough, when the dough reaches the optimum state required for Tiry bread, is determined by calculating the water needed for a known weight of flour and without estimating it by means,of Farinograph. Thus, this percentage specified here is not what is required in the case of this type from the bread due to the required bread-forming process, the absence of the need for the fermentation process, the occurrence of gas bubbles in the dough, and finally, the absence of the need for fluff in the bread.

c- The dough was cut into balls (Goonk), weighing (200) g, and then, the bread was formed using a long, thin wooden roller. It is smooth and differs from the clamp called (Teruk) with a length of (70-80 cm) and a diameter of 1.5-2-cm. The molding process was carried out on a flat, round, smooth wooden board known the (Pan) with a diameter of (70-80 cm), and fine flour was used during the formation of the bread to avoid sticking to each other.

d- The prepared bread brushes on a metal disc-shaped and convex plate made for this purpose and with a diameter of approximately (1 m) and called (Saj), and special oil primers were used as a source Thermal heating to heat this metal plate. When its temperature reaches (210 ^{0}C ±5), we put the bread on the oven

and roast for a period (1.45 - 2.30 minutes), and a pottery oven can be used for the purpose of roasting this type of bread.
e- Two types of Tiry bread were manufactured according to the source and percentage of the flour: wheat and barley flour.

Preparation Tiry Bread from Wheat Flour

Tiry bread is prepared from (100%) percentage of wheat flour with diameter of (40cm), and fine flour was used during the formation of the bread to avoid sticking to each other. Then, the bread is put on a heated (Saj) (210 0C ±5), for the period (1.45 - 2.30 minutes) (Figure 1).

Figure 1: Tiry bred prepared by wheat flour

Preparation Tiry Bread from Barley Flour

For the preparation of Tiry bread, (100 %) of barley flour (Turkish & white barely Kurdish 50-50 %) were used (Figure 2). Thus, fine flour is used during the Tiry bread, whose diameter is (40 cm), to allow sticking, and heated (Saj) at (210 ^{0}C ±5) is used, for the period (1.45 - 2.30 minutes) (Figure 2).

Figure 2: Tiry bred prepared by barley flour.

Chemical Analysis

Moisture and crude protein content: Five hundred grams of each flour sample were used in this experiment to determine percentages of moisture and crude protein directly, using Perten- inframatic 9500 Grain analysis, according to the method of ICC, No.202 (1986) and ICC No.159 (1995), respectively.
Ash content: Five grams of each flour sample were prepared to determine the total inorganic matter according to the basic method given in (AACC, 2000) was cited by (Ahmed et al., 2014).

$$Ash\ content\ \% = \frac{weight\ of\ ash}{weight\ of\ sample} \times 100$$

Wet and Dry Gluten
Firstly, to indicate wet Gluten in the flour, the methods were cited by El-Khayat *et al.*, 2006; Hamdia and Salim, 2017 were used. Wet gluten was washed from whole-grain wheat flour. During the washing of gluten using the standard method, it was observed that gluten dissociated to small particles and was discarded with water. Therefore, it was modified the procedure to use water at (7-10 °C) in order to get the adequate amount of gluten for the further test by using Glutograph according to Brabender (2016). Two parallel of the ribbed round plates are used to comprises in the Glutograph-E's measurement system, and the distance is proportional to each other. The sample was positioned between these plates. And, rotated towards the lower plate to the fixed plate in upper side with constant force. Shearing stress can be varied with shearing angle with power in the same assess. The probe was elongated more or less thickly. Next, shearing angle has been recorded over time. When a certain deviation is reached, the sample is relaxed and its elasticity decreases accordingly. The first part of the chart shows the samples stretching (increase), and the second part shows how the curve drops according to how the sample retracts.

Color Analysis

For indicating color in sample (flour and bread), a Datacolor Spectra (Datacolor International Lawrenceville, NJ, USA) were used in this experiment. In the Datacolor (Spectrophotometer SF 600 Plus), the color of sample is denoted by the three dimensions, L *, a *, and b *. The L *, a * and b *, and readings were developed using color tools (V 3.1). The L * value gives the product a lightness of zero to zero, from 100 to excellent whiteness, as predicted by eye. Redness (+ / greenness − and the yellowness + / blueness −) is indicated by the values a * and b *, respectively. To get the real color in to the sample were measured triple time cited by (Al-Saleh et al., 2012).

Farinograph water absorption

The Farinograph Water Absorption (FWA) was used to determinate the distinct conjugation to portend the hydration rate for bread making procedure. FWA is the volume of water, expressed in (ml / 100 g) of flour at (14.0%) moisture content, demand for manufacturing dough with a higher consistency of (500 Farinograph Unit (FU)) beneath the standard role for the manufactured in Iraqi (AACC, 1984).

Texture Determination

Texture analyzer (Stable Micro-system) is used to analyze the samples, and we press the strip twice at a test speed of 2.00 mm/sec, and we use a p-7 pressure probe with a 60 mm barrel. The hardness with springiness were recorded in this parameters.

Starch Damage

starch damage in flour shows the white color to the dough and gives the good dough in bakery processes (El-Khayat *et al.*, 2006: M Allister *et al.*, 2008). Generally, to determinate the starch damage in flour sample, two essential ways can be found. In this study, the standard methods of starch damage were cited by Allister et al., 2008 were used.

Statistical Analysis

the data were analyzed as mean ± standard deviation using (XLSTAT-pro version 7.5.2.) software for window, the date obtained from the analysis samples were applied one way (ANOVA) with Duncan's multiple range tests at $P<0.05$.

Result and Dissection

In this experiment, wheat flour Turkey (WFT), barley flour Turkey (BFT) and barley flour Kurdish (BFK) were used alone and were mixed to make the Tiry bread. **Table 2** clarified the chemical composition based on dry weight of various flour were used in this studies.

Table 2: Physicochemical properties of WFT, BFT and BFK samples

Treatment	Miosture %	T.S %	Ptotien %	Ash %	Dry gluten fixed %	Wet gluten fixed %	Color L %	Color a %	Color b %	Water absorption fixed %	Starch damage dry basis %
WFT	14.080^{a}	85.920^{b}	10.440^{a}	0.490^{b}	8.730^{a}	26.580^{b}	92.600^{a}	0.350^{b}	7.250^{a}	57.020^{c}	5.110^{b}
BFT	13.820^{a}	86.180^{b}	11.900^{a}	1.700^{ab}	10.220^{a}	29.630^{a}	85.190^{b}	1.590^{ab}	7.820^{a}	62.880^{b}	4.770^{b}
BFK	11.120^{b}	88.880^{a}	11.720^{a}	2.410^{a}	8.590^{a}	23.350^{c}	62.110^{c}	2.150^{a}	8.750^{a}	68.820^{a}	8.660^{a}

Wheat Flour Turkey; WFT, Barley Flour Turkey; BFT, Barley Flour Kurdish; BFK, Total Solid; T.S

The percentage of moisture content ranged from (11.120 – 14.080 %), and there was no significant different between the various flour used in this studies. Also, the moisture content in flour and cereal crops related to the agriculture practices in growing stage and genetic properties of the crops (Bayan and Akeel, 2018). Besides, the total soluble solid (T. S) in sample flour obtained shows no significant different between treatments, the highest T.S was obtained from the BFK (88.880 %), and the lowest T.S was obtained from the treatment WFT (85.920 %). However, the T.S was obtained from treatment BFT (86.180 %), which is ranged between other treatments in comparison with them. When the maximum moisture content was recorded in flour sample (14 %), that is why the date regarded the right T.S. and agreed with (ICC No. 110, ISO 711-2009).

From the industrial milling, the ash and protein content in the flour to indicate the quality of flour and dough that must be assessed (Irakli et al., 2020). Furthermore, the percentage of ash content in the flour sample preformed the mineral content in the food product and shows circumstantially more minerals (Ahmed *et al.*, 2014; Bayan and Akeel, 2018). The ash content in different flour sample were varied and indicated that BFK (2.410 %) was rich in ash content, and this value decreases from WFT (0.490 %).

Saeid *et al.*, 2015, gave and clarified the important note about protein and gluten, and they stated that the quality of gluten is not measured alone to quantity of protein; however, gluten can be measured to flexibility and stretch of the dough. Also, according to Chowdhury *et al.*, 2012, the percentage of protein content in flour higher than the (10-14.5%) is utilized to bread, and the lower percentage protein content (6-10%) indicated the softening of flour and was used to cake and biscuit. The results procured from the samples of flour showed that no significant different between the flour samples, and the BFT had the highest amount of protein (11.900 %) followed by BFK (11.720 %) and WFT (10.440 %), respectively. Despite, the starch in flour is an important parameter to indicate the quality of flour, and the starch is consist of particular, various characteristics (Allister et al., 2008). Thus, high pressure on miller and wheat species directly related with starch damage flour (Putri et al., 2020). The highest percentage value of starch damage was taken from BFK (8.660 %), and the lowest was taken from BFK (4.770 %). Also, Putri *et al.*, 2020, stated that the rate of starch damage will be increased the hardener of wheat and barley, and speed of machine with time, level and rolling the mill. Also, the starch damage affected and related with the amount of water absorption (Jukić et al., 2019).

The amount of ware absorption fixed (WAF) in sample four were not recorded the significant different between the flour samples. The maximum WAF was obtained from BFK (68.820 %), flowed by BFT (62.880 %), and WFT (57.020 %) respectively. Consequently, the number of hydroxyl groups in the fiber structure permiting the water reaction over hydrogen linked, and WAF impacted by starch damage and protein content (Scheuer et al., 2014).

BFT contained (10.220 %) of Dry Gluten Fixed (DGF), WFT approximately contains (8.730 %) of DRF, and found (8.590 %) DGF in BFK; however, the results showed no significant between treatments. Also, BFT contained (29.630 %) of Wet Gluten Fixed (WGF), WFT approximately contains (26.580 %) of WGF, and found (23.350 %) of WGF in BFK respectively. Bayan and Akeel, 2018, conducted a study in which the ratio of the gluten vary from species to species, agriculture practices, and environmental condition in growing stages.

The bright color value of the sample L* shows a significant difference between all the flour samples; the WFT had a high bright (92.600 %) compared with the BFK whose bright color was (62.110 %). Thus, the ratio of ash and protein increased in flour samples directly related to the brightness of flour (Al-Saleh et al., 2012). The redness values of the flour samples *a* * varied from; (0.350 %) for WFT and (2.150 %) for BFK. While the yellowness values *b* * did not show a significant difference in all of the samples. The value *L** of the BFK was higher than the WFT. The colors were showed in the test of sample related to the cereal pigment of flour,

concentration of pigments, genetic factors, type of cultivar, and environmental condition (Al-Saleh and Brennan, 2012; Bayan and Akeel, 2018).

Physicochemical Property of Wheat and Barley Bread

Table 2 clarified the physicochemical properties of different Tiry bread prepared in the experiment and illustrated no significant different between the parameters. The ash values for the wheat bread (WB) and barley bread (BB) samples show no significant difference among them and recorded (1.650 %) ash content in WB and (2.200 %) in BB. Also, Water absorption in Tiry bread were varied between different kind of bread; moreover, the maximum water absorption was obtained from BB (65.820 %), and the lowest was recorded from WB (61.970%). The moisture content in in those two Tiry bread varied from (10.85 %) for WB and for (12.130 %) BB. Thus, this results is agreement with Iraqi standard of moisture in bread, and it is (14 %), and moisture content is important in bread product (Hamdia and Salim, 2017).

In the proses of bread making, one of the substantial standard is protein content in flour to make a bread (Hamdia and Salim, 2017). Protein content in BB (10.680 %) and in WB (10.320 %). As Known, the protein content in flour and bread nearly correlated with gluten (Putri et al., 2020). The wet and dry gluten content in different kind of bread also ranged from (25.160 %) WB, (23.940%) BB, (8.900 %) WB, and (8.670 %) BB, respectively.

The color value of WB and BB were yellowness b^* 12, and the bright color L^* were obtained from the WB and BB samples (81 – 70), and then, the redness value for that experiment a^* obtained from the WB and BB (1.34 – 3.330). That results of color value observed form the sample show not significant different between them. Al-Saleh and Brennan, 2012, state that the color will be changeable depending of the time and temperature ant time of making the bread. However, Ibrahim *et al.*, 2020, regarding the color of bread will be also changeable according of milling reaction toward baking with time and temperature.

Table 3 : Physicochemical properties of wheat and barley bread samples.

Treatment	Moisture %	T.S %	Protein %	Ash %	Dry gluten fixed %	Wet gluten fixed %	Color L %	Color a %	Color b %	Water absorption fixed %	Starch damage dry basis %
WB	10.85[a]	89.150[a]	10.320[a]	1.650[a]	8.900[a]	25.160[a]	81.070[a]	1.340[a]	12.420[a]	61.970[a]	15.580[a]
BB	12.130[a]	87.870[a]	10.680[a]	2.200[a]	8.670[a]	23.940[a]	70.480[a]	3.330 [a]	12.020[a]	65.820[a]	9[a]

WB; white bread, BB; bread barley

Starch damage in bread essentially is related with mechanical rolling during the dough process (Dubat, 2004). The highest percentage of starch damage was recorded in WB (15.580 %), and the lowest was obtained from BB (9.00 %). Also, the ratio of starch damage in dough have a positive impact on the starch damage and absorption too much water, and it helps the rise the yield of bread. However, absorption more water affected the dough cannot be make a form easily (Dubat, 2004; Jukić *et al.*, 2019).

In Table 4, the difference between the hardness of various bread were Illustrated, and it is very high, due to the difference between each bread type from different resources such as waterlogging mechanism between wheat and barley. The hardness rate ranged between bread (285 g -266.500 g) in WB, and (94.90 g – 85 g) in BB.

Table 4**:** Texture analysis of wheat and barley bread samples

Treatment	Hardness1/g	Hardness 2/g	Cohesiveness	Springiness/mm
WB	285	266.500	0.550	4.700
BB	94.90	85	0.770	0.767

WB; white bread, BB; bread barley

Cohesiveness for sample BB is 0.77, which is almost identical to the reference. However, we significantly see a very different springiness for WB is 4.700, and this due to the content of our bread sample, made of (wheat flour, salt and water), without adding any thickener making factor or item. In sample BB is very close to the normal rate which is 0.767.

Conclusion

The results of physical properties and chemical properties in this experiment have demonstrated no significant difference between the wheat and barley flour, and their products. The wet gluten fixed in BFT is higher than all flour samples. WFT had a higher color *L** compared to BFK. Also, WFT had lower water absorption fixed than the BFK. The WB color *L** and starch damage dry basis are higher than the BB. The WB water absorption fixed had lower than the BB. The WB has higher hardness 1, hardness 2 and springiness compared with BB. The WB and BB Cohesiveness had no significant difference between them. Thus, it is recommended to the people to eat this bread, because it is healthier than the other bred. Moreover, it is recommended to the researchers to make more study about the mineral and element content of Kurdish Tiry bread.

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