PKP
PUBLIC KNOWLEDGE PROJECT

Journal of Biological Studies
ISSN 2209-2560

JBS
An Open Access Peer Reviewed Journal

Research Full-Text Paper

Evaluation of quality parameters in some types of wheat flour used for different purposes

Alketa Shehaj[1]*, Klotilda Marku[1], Ariola Morina[1], Albes Rama[2]

[1] *Department of Agricultural Food, Faculty of Biotechnology and Food, Agricultural University of Tirana, Street 'Paisi Vodica', Koder-Kamez, 1029 Tirana, Albania*
[2] *Miell Tirana" Factory, Bulevardi "Teodor Keko", Rruga "Agim Qarri" Nr. 1 Tiranë, Albania*

Received: January 2,2022; Accepted: February 10,2022; Published online: April 10,2022

Abstract

Wheat flour is generally produced by milling wheat until a fine powder is produced. The flour is used for different purposes, generally for the preparation of baked products. This study aims to analyze and evaluate the quality of the flour that is traded on the market in Albania, such as T00, T0, all-purpose, whole grain, etc. produced in Albania or abroad. A total of 20 flour samples were purchased from the market and the technical properties such as water absorption, stability, sedimentation, dough energy and some physical and chemical properties such as moisture, total ash, acidity, protein and gluten were evaluated. Analyses were conducted according to AACC standards. The results show that all samples have almost the same parameters as described on the labels. Protein content ranged from 9.6 to 16.6%, with the highest percentage found in sample IFW0. Water absorption ranged from 58.5 to 65%, with sample AFA1 having the highest value. Acidity is the most commonly used parameter to determine storage conditions, and all samples had a low value. It ranged from 0.65 to 0.8%, with the highest value found in whole wheat flour. The gluten content varied from 18 to 35.7%, with the highest value detected in sample IFW0. According to the analysis of the samples, the wheat flour sold in the Albanian market has good parameters regarding the amount of protein, gluten, water absorption etc. They are different for different types of flours and we recommend consumers to read the label carefully before buying.

Keywords: Wheat flour, Quality evaluation, Water absorption, Protein, Gluten

*e-mail: ashehaj@ubt.edu.al

1 Introduction

Flour is a product that is wildly used in our daily life in order to produce baked products like bread, pasta, biscuits etc.

In the market exist a lot of different types of flour that vary according to:

- type of grain used (wheat, maize, rice, oat etc)
- different mixture of parts of the grain (T00, T0 , whole wheat grain etc)
- the purpose of usage (pasta, all-purpose usage, bread, etc)
- etc

Wheat is an important part of the diet in most countries of the world because it is agronomically adaptable, easily stored, has good nutritional value, and a variety of tasty, interesting, and satisfying foods can be made from its flour. Doughs made from wheat flour are distinguished from those made from other grains by their unique viscoelastic properties (Carson and Edwards, 2009).

This property is the reason for the universal use of wheat for a wide range of products. These include pan bread, pasta, cakes, biscuits/cookies, bread, doughnuts, croissants, bagels, pizza, flatbread, and chapatti. Each of these products is ideally made from wheat selected to provide flour with the desired characteristics. *Moss et, al* have summarized the requirements for the balance of grain hardness and protein content for several common products. Accordingly, flour with a protein content of less than 9% is used for the production of cookies, cakes and pastries. Wheat flour with a protein content of 9-11.5% can be used for making pudding, thickener for canned food, etc. Flour with a protein content of 11.5% and above can be used for bread making, and 13% and above can be used for pasta making (Moss, 1973).

Generally, wheat has been classified according to the place of production (Carson and Edwards, 2009) and each place has developed subclasses with a specific use, such as Manitoba from Canada, Rosafe from Argentina, Dajti and Agimi from Albania, etc.

The production of wheat flour affects the quality of flour components and technological properties. The main stages of wheat flour production are: Cleaning from impurities, milling and physical phase separation.

The quality of flour is studied from two aspects:

• Nutritional value (the amount of chemical content: Protein, carbohydrates, fats, ash, moisture, vitamins, fiber content, etc.). Since wheat flour is used in many different bakery products, it is important to determine the amount of chemical content. In this study, we have determined some of the chemical and physical properties that are important for the quality of the flour. The quality of flour is mainly determined by the amount of protein it contains. The higher the protein content, the greater the product volume (Cauvain, 2015).

• Technological properties are mainly related to the quality of protein (gluten) and starch. When water and wheat flour are mixed, a network of proteins called gluten is formed. The protein fraction responsible for gluten is prolamins and glutelins. They give the dough the unique properties of viscoelasticity, the ability to bind gas and water and increase volume during the fermentation process (Bailey, 1941).

This study aims to determine and evaluate the quality of wheat flour traded in the Albanian

market according to the above criteria.

In Albania, some good companies produce flour from imported wheat from all over the world. These companies produce different types of flour, T00, T0, all-purpose flour, whole wheat flour, etc. Due to customer demand in the market, we can even find flour produced abroad.

Determination of chemical and technological properties of flour is very important, as they help to evaluate the quality of the flour from the above aspects.

2 Materials and Methods

In this study, 20 samples of wheat flour were investigated to determine some physical and chemical properties such as moisture, ash, protein, gluten and some technical properties such as water absorption, energy and stability of the dough, sedimentation, etc.

All samples were purchased in the Albanian market and 10 were selected from foreign brands and 10 from Albanian brands. There were different types of flour, T00, T0, all-purpose flour and integral flour. All samples were coded and stored in a place with controlled humidity and temperature until the time of.

2. 1. Determination of moisture content

Moisture content was determined using Method 44-15 A, a method approved by the AACC. In this method, a small amount of flour (2-3 g) is weighed and placed in a moisture pan, and then the sample is heated in an air oven at 130°C for 1 hour. Then the sample is cooled and weighed (AACC Approved Method, 44-15.02).

2. 2. Determination of total ash.

A sample of 3-5 grams of flour is weighed and placed in an ash pan. The sample is heated at 585°C in an ash furnace until its weight doesn't change. The residue is cooled to room temperature and then weighed as described in AACC Method 08-01 (AACC Approved Method, 08-01.01).

2. 3. Determination of protein

A sample of 0.15-0.20 grams of flour is weighed and placed in a protein analyzer from Combustion Nitrogen Analyzes. This process is fully automated and begins by placing the sample into a hot furnace where it is combusted at 952°C. The amount of nitrogen gas released during combustion is measured and converted to the protein content of the sample using a formula (AACC Approved Method, 46-30.01).

2. 4. Determination of gluten

As described in Method 38-12 of the AACC, a 10-gramme flour sample is weighed and placed on the polyester sieve in the glutomatic wash chamber. The sample is mixed and washed with a 2% salt solution for 5 minutes. The wet gluten is removed from the wash chamber, placed in the centrifuge holder and centrifuged. The residue retained on top of and through the

sieve is weighed (AACC Approved Method, 38-12.02).

2. 5. Determination of sedimentation

The sedimentation test is a physicochemical test that provides information on the baking quality of wheat flour. It is based on the suspension of flour in a dilute alcohol and acid solution, which causes the flour particles to sediment. The determination of the sedimentation test was carried out according to AACC method 56-61.02 (AACC Approved Method, 56-61.02).

2. 6. Determination of TTA in flour

Determination of the total titratable acidity according to AOAC 943.02, 981.12, and AACC 02-31.01 where an appropriate amount of sample is weighed into the sample beaker and CO_2-free water is added. The sample is homogenized is allowed to stand for 30 minutes. For the TTA measurement, the solution is titrated until after the first equivalence point with standardized sodium hydroxide solution is reached (AOAC, 2010).

3 Results and Discussions

All the data obtained from the test are shown in the table below:

Table 1. Result of physico-chemical and technological properties of wheat flour.

Code	Moisture (%)	Ash (%)	Crude Protein (%)	Wet Gluten (%)	Acidity (%)	Water Absorption (%)	W (flour's strength)	Zeleny (ml)
IFW1	11.8±0.24	0.53±0.27	12.5±0.29	22.1±0.27	0.62±0.28	59.6±0.45	193±0.29	29±0.76
AFA0	11.5±0.15	0.65±0.21	11.5±0.34	22.8±0.45	0.67±0.23	64.8±0.28	150±0.06	25±0.88
AFA1	11.7±0.13	0.7±0.32	11.7±0.21	23±0.25	0.71±0.26	65±0.23	153±0.39	25±0.46
AFA2	12.1±0.21	0.58±0.26	11.4±0.35	22.7±0.36	0.73±0.31	64.1±0.51	157±0.51	26±0.84
IFE0	12.2±0.23	0.55±0.54	10.3±0.26	18.2±0.52	0.65±0.29	60.2±0.38	156±0.38	20±0.53
IFE1	12.4±0.17	0.56±0.39	10.8±0.27	18.4±0.12	0.67±0.32	59.1±0.62	155±0.48	25±0.83
AFP0	12.3±0.15	0.49±0.24	11.9±0.51	25.6±0.82	0.635±0.32	61.8±0.41	241±0.52	28±0.76
AFP1	12.1±0.26	0.45±0.35	11.6±0.53	23.7±0.62	0.634±0.35	62.5±0.53	243±0.19	26±0.59
AFP2	12.6±0.34	0.51±0.15	12.7±0.48	26.2±0.36	0.714±0.31	61.8±0.74	238±0.27	31±0.43
IFW0	12.1±0.36	0.67±0.42	16.6±0.27	35.7±0.25	0.682±0.42	60.4±0.26	333±0.32	43±0.81
IFI0	11.8±0.24	0.69±0.27	11.2±0.3	25.6±0.16	0.851±0.82	65.3±0.55	151±0.17	21±0.41
IFI1	11.9±0.32	0.64±0.15	9.9±0.52	23.6±0.34	0.853±0.39	64.3±0.57	153±0.43	22±0.26
IFI2	11.7±0.53	0.99±0.42	12.5±0.46	29±0.28	0.854±0.85	64.9±0.39	157±0.39	21±0.5
IFA0	12.1±0.57	0.56±0.55	11.2±0.27	20.1±0.49	0.671±0.34	60.4±0.52	156±0.25	24±0.33
IFA1	12.2±0.36	0.55±0.47	11.6±0.53	23.1±0.32	0.627±0.32	61.8±0.69	153±0.44	23±0.18

IFA2	12.4±0.57	0.56±0.53	10.8±0.21	18.4±0.32	0.681±0.33	59.1±0.57	155±0.72	25±0.22
IFE2	12.1±0.39	0.54±0.45	9.6±0.32	18±0.57	0.679±0.25	62.3±0.25	154±0.53	15±0.69
IFW2	11.8±0.37	0.55±0.39	15.2±0.41	29.6±0.39	0.713±0.32	58.5±0.39	319±0.19	43±0.53
AFI0	11.8±0.26	0.68±0.57	11.9±0.36	28±0.27	0.813±0.11	64.8±0.57	157±0.35	24±0.47
AFI1	12.1±0.45	0.67±0.24	11.6±0.21	26±0.27	0.844±0.13	65.2±0.25	153±0.22	23±0.52

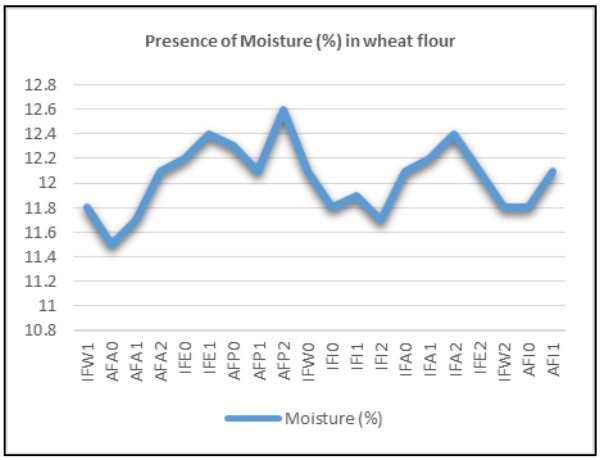

Fig. 1. Presence of moisture in wheat flour

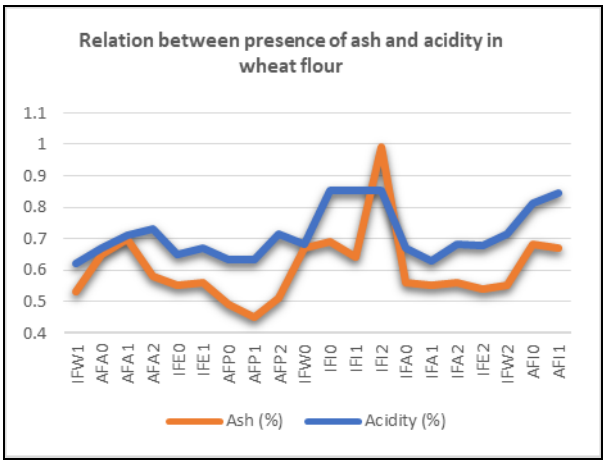

Fig. 2. Relation between presence of ash and acidity in wheat flour

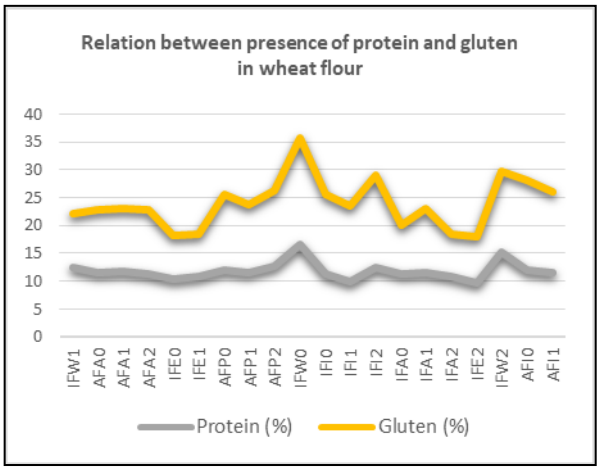

Fig. 3. Relation between presence of protein and gluten in wheat flour

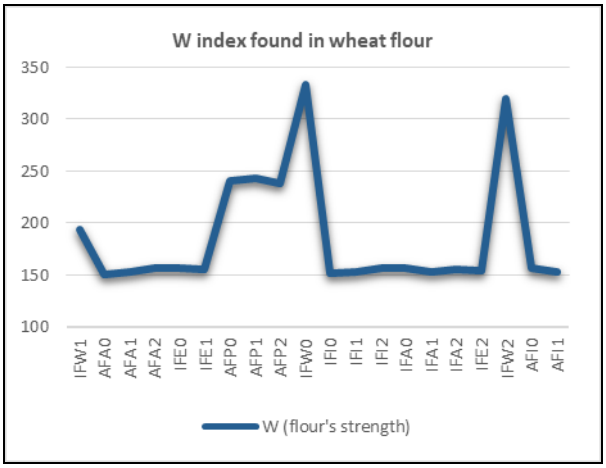

Fig. 4. W index found in wheat flour

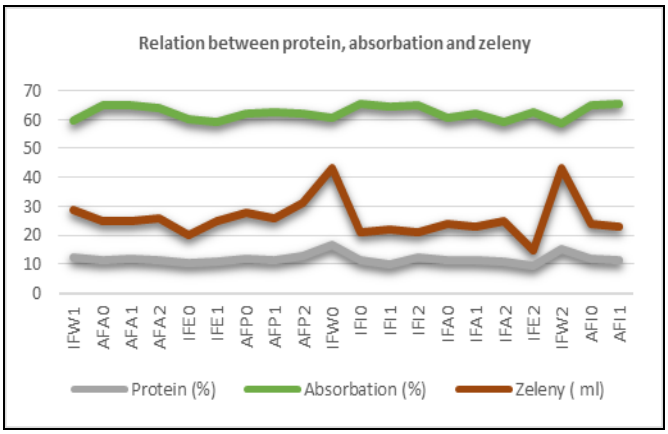

Fig. 5. Relation between protein, absorption and zeleny

The result presented in Table 1 has provided some valuable information about the quality of flour in the Albanian market.

If we evaluate all the results, the moisture content is between 11.5 and 12.6%, which shows that all the samples have a moisture content lower than the value described in the Official Journal of the European Communities, 2000/C312/01 (EUR-Lex, 2000).

The ash content ranges from 0.45-0.99% and was higher in samples IFI0/1/2 and AFI0/1. All these samples were whole wheat flour. According to OJEC 200/C312/01, the ash content should be a maximum of 0.6%, which is met by all our samples, except the sample that has the highest value of 0.99%.

The protein content ranges from 9.6-16.6%, with the highest value found in the sample IFWO, an Italian product. According to OJ 200/C312/01, the minimum value for protein should be 10.5%, and in our sample, only two samples were below this limit. The protein content in wheat flour is an indicator of the quality of the flour and also indicates the water absorption since there is a correlation between these two parameters: 1.3 g of water per 1 g of protein (Cauvain, 2015), so variations in protein also affect the water absorption of the flour. Figure 5 shows the relationship between protein content and water absorption.

The determination of gluten in wheat flour has shown that the value ranges from 18-35.7%. The higher value of gluten was found in IFWO, which also has the higher value of total protein content. Most samples have shown that there is a correlation between protein content and gluten content in wheat flour.

Titratable acidity has shown that all samples have a low value, ranging from 0.62 to 0.844%, with the higher values found in whole wheat flour.

The Zeleny index, related to the sedimentation process, is expressed in ml and depends on the quantity and quality of gluten. Higher sedimentation values indicate a high amount of protein and stronger gluten. According to OJEC 200/C312/01, the Zeleny index should be at least 25. Our data showed that the value ranges from 15 to 43, with the lowest value found in sample IFE2, which has an even lower value. Figure 5 shows this correlation between the amount of protein and the Zeleny index.

The W-index indicates the strength of the flour and is related to the protein and gluten. In

general, flour with a higher W-index requires a longer rise time for fermentation and retains CO2 better. All values obtained ranged from 150 to 333 (La forca della farina, 2009).

4 Conclusion

In this study, 20 samples of wheat flour were analyzed for some physical and chemical properties. Some technological properties were also determined. According to the analyses, most of the samples met the specifications of OJEC 200/C312/01, and the sample IFWO has the higher values for protein, gluten, W-index and water absorption. There is a correlation between the protein content, gluten content, water absorption, W-index and sedimentation process, as also mentioned by Gordon R. Carson et al (Wrigley, 2009). Most of the data taken from the analyses were consistent with the information on the label of the flour. We recommend all consumers read the label for the purpose of use.

Acknowledgments

We thank the "Tirana Mill" Factory for all their support for providing as an accredited laboratory in order to conduct our study and we also want to thank the staff of the "Global Research, Education & Event Network" for all their help and their support.

Conflict of interests

All authors declare that they have no conflicts of interests.

References

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 08-01.01, determination of ash.

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 46-30.01 Crude Protein—Combustion Method.

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 44-15.02 Moisture—Air-Oven Methods

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 56-61.02 Sedimentation test for wheat.

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 38-12.02 Wet Gluten, Dry Gluten, Water-Binding Capacity, and Gluten Index.

AOAC. Official methods of analysis, 25th end. (2010). Washington, DC: Association of Official Analytical Chemist, AOAC 943.02, 981.12, pH value and the total titratable acidity and

American Association of Cereal Chemists Approved Methods. Stati Uniti: The Committee, 2000 Method 02-31.01, acidity determination

Bailey, C. H. (1941). A translation of Beccari's lecture 'Concerning Grain'1728. Cereal Chem, 18(5), 555-561.

Carson, G. R., & Edwards, N. M. (2009). Criteria of wheat and flour quality. Wheat: chemistry and technology, (Ed. 4), 97-118. https://www.cabdirect.org/globalhealth/abstract/20093327186

Cauvain, S. P. (2015). Technology of Bread making. https://doi.org/10.1007/978-3-319-14687-4

EUR-Lex, Official Journal of the European Communities, 2000/C312/01, 8. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2000:312:0001:0026:EN:PDF

La forca della farina, 28 January 2009. Archived from the original on April 2019. Link: https://bressanini-lescienze.blogautore.espresso.repubblica.it/2009/01/28/la-forza-della-farina/

Moss, H. J. (1973). Quality standards for wheat varieties. *Journal of the Australian Institute of Agricultural Science*. 39:109-115

Wrigley, C. W. (2009). Wheat: a unique grain for the world. *Wheat: Chemistry and Technology*, (Ed. 4), 1-17. https://www.cabdirect.org/cabdirect/abstract/20093327175