#### **RESEARCH ARTICLE**

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# **Chemical - Technological Indices of Wheat as Very Important Indicators of its Quality**

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#### Abstract

The purpose of this study is to analyze the biochemical-chemical-technological indices in some soft and wheat lines of the collection of the AUT Genetic Resource Center, planted in the experimental didactic economy of the Agricultural University of Tirana (AUT), during the years 2012-2013. The results of the study for soft wheat lines showed a relatively high protein content (averaging 12.65%), while low values of wet gluten (averaging 23.37%) were identified. High values resulted for sedimentation coefficient and gluten index (averaging 83.38 ml and 80.87%, respectively), as well as in the specific volume of sediment (averaging 6.63). Statistical analysis of qualitative and quantitative indices values, showed significant positive linkages between protein and wet gluten, r = 0.81 Data on the composition of glutenin subunits with HMW, which were analyzed by sodium- dodecyl- sulphat-

polyacrylamid-gel electrophoresis (SDS-PAGE), showed that seven out of ten soft wheat lines are characterized by the content of glutenin subunits 5 + 10, while the K9 line, by the content of glutenin subunits 5 + 10, and 2 \*, which test for good baking qualities.

From the complex evaluation of the above indices, it is advised the use of qualitative study lines in the genetic improvement work for quality, for the creation of quality wheat cultivars.

Keywords: Wheat quality, protein, HMW-GS, gluten, SDS-PAGE

### 1. Introduction

Today's wheat originates from wild ancestral species. Wheat is the staple food of most of the world's population. Extensive use of cereals, especially wheat, is associated with high nutrient content, with the easy assimilation of their chemical content by the human body [35].

The development of agriculture and cereals occupy an important place in the ancient tradition and people's cultural heritage. Our ancient tradition, inherited from generation to generation, is constantly enriched with new elements of cereal and plant cultivation [35]. Aegilops (relatives of wheat) have contributed to wheat multiplication programs as well as to the improvement of complex traits, such as yield, drought and heat tolerance [21]. Our research-scientific institutions in cooperation with foreign ones work continuously, that in addition to increasing production indicators, also work towards improving the quality of grain. Protein content is an important indicator of wheat grain quality. Referring to studies conducted in our country, the protein content varies between 11.00% - 15.25% [22], 13.70% - 16.06% [5], 12.11% - 14.57% [6], 13.51% - 15.38% [7], 12.57% - 16.95% [8], 14.00% - 21.07% [9], 12.42% - 15.60% [10], 12.47% - 17.00% [11], 13.29% - 16.64% [12]. Wheat cultivars created in our country have occupied

over 70% of the area in the plantations of 1985 -1986.

\*Corresponding author: Valentina Arapi; E-mail: valiarapi@hotmail.com Special Issue of the Conference:Agriculture a Life Science with Roots in Applied Biology; 3-4 Dec.2020. (Accepted for public. 22.01.2020) ISSN: 2218-2020, © Agricultural University of Tirana Dajti cultivar, soft wheat, created by the Department of Plant Genetics of ILB, was planted in a larger area compared to other cultivars. This cultivar is characterized by high yields (60 - 70 kv /) ha and has good ecological suitability [35]. Protein content fluctuates between 11.98% [22], 13.70% [5], 12.11% [6].

Glutenin is the protein best known for its role with gliadinas in the formation of gluten. Subunits of High molecular weight (PML) glutenins of bread wheat are important determinants of quality of the final product [34], [29], [25], [4].

The purpose of this study is to analyze the biochemical-chemical-technological indices in some soft wheat lines of the collection of the Center of Genetic Resources, UBT and the use of quality lines in the genetic improvement work for the creation of high quality wheat cultivars.

# 2. Material and Methods

In order to conduct this study, 10 lines of soft wheat were analyzed from the collection of the UBT Center for Genetic Resources and four Aegilops wheat (15cylinder Aegilops wheat, 22-cylinder Aegilops grain, 3-cone Aegilops grain, 16-cone Aegilops grain) were analyzed, planted in the experimental didactic economy of the Agricultural University of Tirana (UBT), during the years 2012 -2013, as well as the soft wheat cultivar Dajti, planted in the years 2017-2018 in Ravonik (Korça), 2018-2019 in Fushë Korça and Veliten (Korça), and 2018-2019 in Përmet In the wheat lines, biometric and production indicators were analyzed: plant height, grain length, number of grains per grain, weight of 1000 grains, volumetric weight, vegetative cycle, production in ha-1 (t) [32]. 10 lines of soft wheat from UBT collection and samples of soft wheat Dajti and Pishë Poro, after cleaning and drying at room temperature were ground in a Perten 3100 mill. Moisture content was determined by the method of drying the samples in a thermostat at 110 ° C [13].

The total protein content was determined by the Kjeldahl method [3], where the detected nitrogen was multiplied by a factor (5.7 for wheat), which corresponds to the crude protein in the analyzed wheat sample. The wet gluten content and Gluten Index were defined according to Glutomatic System, Gluten Index, Perten, ICC Standard N0155 and N0 158 AACC (2000) Method N0 38-12, [2]. International Gluten Index method is faster than the 'manual washing gluten' method and it uses a relatively small

amount of flour sample during the analysis15]. The sedimentation coefficient (K-SDS) was determined according to Axford et al., [1], Zeleny [36]. High molecular weight glutenine subunits (HMW-GS) were fractionated by SDS-PAGE (Laemmlli [20]), the running gel was 10% acrylamide solution and 0.3% bis-acrylamide, pH 8.8, while the stacking gel was 5% acrylamide solution and 0.09% bis-acrylamide, pH 6.8. The numbering system for soft wheat was determined according to Payne and Lawrence (Payne and Lawrence [24]) and Payne (Payne [26.]), and quality score according to Pogna (Pogna [27]. All samples of soft wheat were analysed twice and data were reported based on dry material. The biometric indicators for each line were calculated as the average of the 10 subsequent measurements. Descriptive statistics and correlation coefficients were estimated through the STATA 14 statistical package.

## 3. Results and Discussion

Table 1 presents the results of some biometric parameters of plant, cob, grain and production for 10 soft wheat lines of the collection of the Center of Genetic Resources of UBT. As shown in the Table, the height of the wheat plant reached between 75.00 cm to 98.00 cm (lines K3, K9), with an average of 86.50 cm. The length of the cob reached between 8.60 cm and 9.80 cm (lines K5, K8 and K1, K6), with an average of 9.22 cm. The number of grains per cob ranged from 44 to 52 grains, with an average of 47.60. The weight of 1000 grains was approximately the same in all soft wheat lines of the UBT collection with an average of respectively 43.70 gr. Volumetric weight varied 72.00 kg to 78.00 kg (lines K3 and K7, K8, K10). Production indicators fluctuated in values from 5.4 t / ha to 7.1 t / ha (lines K6, K2), with an average of 6.1 tons / ha, while the vegetative cycle was limited from 192 days to 209 days (lines K6, K3) [22]. The 10 soft wheat lines of the UBT collection, showed a very good resistance to fusarium wilt (except line K1), rust (except lines K6, K10), rust (except line K6, K10). While they showed a good resistance to collapse and above average to the lemma insect (except for lines K2, K6, K10 and K5, K6, K9, K10) [37], [31], [33], [35].

Nr.	Wheat	Plant	Cob	Nr. of	Weight	Volumetri	Vegetative	Producti
	Lines	Height	Length	Grains/Co	of 1000	c weight	Cycle	on in
		cm	cm	b	grain gr	kg	(days)	Tons/Ha
1	K1	78.00	9.8	52	41	73	205	6.30
2	K2	76.00	9.40	48	42	74	207	7.10
3	K3	75.00	9.60	50	41	72	209	6.20
4	K4	88.00	8.80	46	43	74	194	6.10
5	K5	96.00	8.60	46	48	77	196	5.50
6	K6	78.00	9.80	50	42	76	192	5.40
7	K7	98.00	8.80	44	46	78	207	6.10
8	K8	86.00	8.60	46	42	78	196	6.20
9	K9	98.00	9.20	48	44	76	203	5.90
10	K10	92.00	9.60	46	48	78	194	6.20

Table 1. Biometric indicators of plant, cob, grain and production in 10 soft wheat lines of AUT collection.

Table 2 presents the values of chemical-technological indicators in the 10 soft wheat lines of the collection of the Center for Genetic Resources of UBT. Protein content and composition is the most important indicator of the quality of wheat for bread [17], [30], [23], [14]. As shown in Table 2, the protein content varied between 11.12% -14.23% (lines K6, K2) with a relatively high average, 12.65% [30], [32]. Moisture content resulted in satisfactory average values (12.26%). The quality of wheat flour is related to the amount and quality of gluten [15], [19]. Meanwhile low values of wet and dry gluten (average 23.37% and 7.31%) were identified. Dry gluten (GTh) is directly related to wet gluten (GP), and the features of their

variation were similar [16]. Lines 2 and 4 were characterized by high values (28.20%) to medium (27.40%) of wet gluten and average values of dry gluten (8.50% and 8.50%) [9]. The gluten / protein ratio averaged 1.84. The gluten index values in the soft wheat lines obtained in the study resulted in high values, averaging 80.87%. According to Curic D. et al, the optimal values of the gluten index for bread production were between 75 and 90% [15]. Also, the sedimentation coefficient SDS (K-SDS), as an indicator of protein quality, resulted in high values, averaging 83.38% (28). Soft grain lines of the UBT collection showed optimal values of specific sediment volume of SDS (average 6.63).

Table 2. Some chemical-technological indexes in 10 soft wheat lines of AUT collection.

Nr.	Wheat	Humidity	Protein	Wet	Dry	Gluten	K-	Ratio	Ratio
	Lines	%	Nx5.7	Gluten	Gluten	Index	SDS	K-SDS	Gluten
			%	%	%	%	ml	/protein	/Protein
1	K1	12.37	12.20	23.20	7.20	63.36	75.50	6.18	1.90
2	K2	12.51	14.23	28.20	8.50	67.37	80.70	5.67	1.98
3	K3	11.91	11.95	20.00	6.50	92.50	7370	6.16	1.67
4	K4	11.40	13.87	27.40	8.50	50.00	84.10	6.06	1.97
5	K5	12.13	13.98	24.20	7.20	96.69	82.40	5.89	1.73
6	K6	12.42	11.12	22.10	6.80	60.18	89.20	8.02	1.98
7	K7	12.17	12.72	24.80	7.60	84.68	78.90	6.20	1.95
8	K8	13.10	13.22	23.80	8.00	97.06	92.60	7.00	1.80
9	K9	12.62	11.68	1810	6.00	97.79	84.10	7.20	1.54
10	K10	12.01	11.61	21.90	6.80	99.09	92.60	7.97	1.88

Table 3 presents some quality indicators of the Dajti cultivar, planted in Korça and Përmet in the years 2017-2018, 2018-2019. The protein content in the Dajti cultivar resulted in high values (13.98%, 12.52% 12.44%), respectively in Fushë Korçë, Veliten,

Ravonik. While the content of raw gluten varied from the minimum values (24.50%, 25.90%) to high values (29.60%) respectively in Ravonik, Veliten and Fushë Korçë. The gluten / protein ratio resulted in values of 1.96, 2.06 and 2.11, respectively in Ravonik, Veliten, Fushë Korçë. The gluten index resulted in high values (96.00%), 95.00%, 74.00%, respectively in Ravonik, Veliten, Fushë Korçë. SDS sedimentation test was limited from good values (46.60 ml, 55.10 ml) to high values (94.30 ml) respectively in Fushë Korçë, Ravonik, Veliten. High values of specific sediment volume (7.53) resulted in Veliten. While the Dajti

cultivar planted in the Përmet area resulted in high values of protein content (13.25%), wet gluten (31.20%), dry gluten (10.20%), SDS sedimentation test (70.70 ml) and average values of gluten index (56.20%). The moisture content resulted in the value of 11.21%. The specific volume of sediment was limited to 5.33.

Table 3. Some chemical-technological indicators for Dajti cultivar, in the years 2017-2018, 2018-2019

	Wheat Lines	Humidity	Protein	Wet	Dry	Gluten	K-	Ratio	Ratio
		%	Nx5.7	Gluten	Gluten	Index	SDS	K-SDS	Gluten
			%	%	%	%	ml	/protein	/Protein
1	Dajti,Ravonik								
	(2017-2018)	13.39	12.44	24.50	8.80	96.00	55.10	4.42	1.96
2	Dajti, Fushë Korçë								
	(2018-2019)	12.66	13.98	29.60	10.30	74.00	46.60	3.33	2.11
3	Dajti, Veliten Korcë								
	(2018-2019)	13.30	12.52	25.90	9.00	95.00	94.30	7.53	2.06
4	Dajti, Përmet								
	(2018-2019)	11.21	13.25	31.20	10.20	56.00	70.70	5.33	2.35

The statistical results of qualitative and quantitative values for 10 soft wheat lines of the UBT collection, showed significant positive correlations between protein and wet and dry gluten with r = 0.81, r = 0.81. A significant positive correlation was observed between the weight of 1000 grains and plant height (r = 0.80). Also, a significant positive correlation with r = 0.79, was observed between the number of grains per cob and the height of the cob. Correlation analyses also showed that volumetric weight had a positive correlation with K-SDS (r = 0.71), plant height (r = 0.71), plant height

0.71) and 1000 grain weight (r = 0.70). Between production indicators and wet gluten, dry gluten and protein, positive correlation were observed (r = 0.45, r = 0.51, r = 0.39). While between the gluten index and fresh gluten a negative correlation resulted (r = -56). For the Dajti cultivar, correlation analysis showed a significant positive correlation between protein content and wet and dry gluten with r = 0.97, r = 0.99. While between K-SDS and the gluten index a positive correlation was observed (r = 0.60).

**Table 4.** Composition of glutenin subunits with PML encoded by chromosome 1A, 1B and 1D and their point evaluation according to Pogna (27).

Wheat Lines	Glutenin S	Subunits with	Point Evaluation, X	
	(Chr	omosome)	(Pogna)	
	1A	1B	1D	
Linja K1	N	-	5 + 10	8
Linja K2	N	6	2 + 12	4
Linja K3	N	20	5 + 10	9
Linja K4	N	20	2 + 12	5
Linja K5	1	7	5 + 10	11
Linja K6	•	6+8	5 + 10	7
Linja K7	•	7	2 + 12	4
Linja K8	1	7	5 + 10	11
Linja K9	2*	20	5 + 10	12
Linja K10	1	7	5 + 10	11
Grurë Aegilops 15 cilindrik	1	8, 9	12	3
Grurë Aegilops 22 cilindrik	1	8, 9	12	3
Grurë Aegilops 3 konik	1	8, 9	2 + 12	5
Grurë Aegilops 16 konik	1	8, 9	2 + 12	5

From the data of **Table 4** it results that among the 10 soft wheat lines of the UBT collection, seven of them contain glutenin subunits with PML 5 + 10 (chromosome 1D), which testify to good baking qualities [18], [27]. Lines K5, K8, K9, K10, resulted in high quality rating values (X), 11, 11, 12, and 11 respectively. Wheat line K9 is distinguished, with a high point rating (X), 12, which also contains glutenin subunits with PML 2 \* (chromosome 1A) and glutenin subunit with PML 5 + 10. While four samples of Aegilops wheat (Aegilops grain 15)

cylindrical, Aegilops grain 22 cylindrical, Aegilops grain 3 conical, Aegilops grain 16 conical), resulted in low values of point evaluation due to the presence of glutenin subunits with low PML. But the four samples of Aegilops wheat contained subunit 1 (chromosome 1A) of glutenin with PML, responsible for good baking qualities.

Graphic representation of proteins, wet gluten, K-SDS values and gluten index in 10 soft wheat lines of the UBT Center for Genetic Resources collection for the years 2012-2013, are shown in Figures 1-4.



Figure 1. Graphic representation of protein and gluten values in 10 soft wheat lines of the UBT collection



Figure 2. Graphic representation of protein and K-SDS values in 10 soft wheat lines of the UBT collection.



Figure 3. Graphic representation of protein and gluten index values in 10 soft wheat lines of the UBT collection



Figure 4. Graphic representation of protein, gluten, K-SDS and gluten index values in 10 soft wheat lines of the UBT collection

## 4. Conclusions

From the complex evaluation of the chemicaltechnological indicators and biometric and production parameters for the 10 soft wheat lines of the UBT collection, it resulted, a moderately high protein content and values ranging from low to high of wet & dry gluten. On the other hand, SDS sedimentation test and gluten index resulted in high values. Also, the specific volume of sediment which is an indicator of protein quality resulted in moderately high values. Correlation analysis showed a significant positive correlation between protein content and wet and dry gluten. Also, a significant positive correlation was observed between the weight of 1000 grains and the height of the plant, such as the number of grains per cob and the height of the cob. Correlation analyses also showed that the volumetric weight had a positive correlation with K-SDS, with plant height and 1000grain weight.

From the results of the composition of glutenin subunits with PML, in 10 soft wheat lines of the UBT collection, it resulted that seven of them contain glutenin subunits with PML 5 + 10 (chromosome 1D), while the K9 line, from the content of glutenin subunits 5 + 10, and 2 \*, which are responsible for

good baking qualities. Lines K5, K8, K9, K10, resulted in high quality assessment values. While four samples of Aegilops grain (Aegilops grain 15 cylindrical, Aegilops grain 22 cylindrical, Aegilops grain 3 conical, Aegilops grain 16 conical), resulted in low values of point evaluation, but in these samples the presence of subunit 1 (chromosome 1A) of PML glutenins, responsible for good baking qualities. Dajti cultivar planted in Korça area (Ravonik, Fushë Korëë and Veliten), resulted in high values of protein content, low to high values of wet and dry gluten, good to high values of test SDS sedimentation and high gluten index values. While the Dajti cultivar planted in the Përmet area resulted in high values of protein content, wet and dry gluten, SDS sedimentation test and average values of gluten index. For the Dajti cultivar, correlation analysis showed a significant positive correlation between protein content and wet and dry gluten.

From the complex evaluation of the above indices, it is advisable to use these quality lines in the genetic improvement work for the establishment of high quality wheat cultivars. While the Dajti cultivar due to its optimal qualitative and quantitative indicators should continue to spread in the varietal structure.

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