J Biochem Technol (2021) 12(1): 11-16
https://doi.org/10.51847/D2JTs9fB5R
ISSN: 0974-2328

A New Naked-Spelt Variety to Enhance Human Immune Function

Sulukhan Temirbekova*, Yuliya Afanasieva, Marat Begeulov, Ivan Kulikov, Olga Beloshapkina, Irina Sardarova

Received: 18 November 2020 / Received in revised form: 04 March 2021, Accepted: 07 March 2021, Published online: 11 March 2021

Abstract

A new variety of naked spelled (Grimme) has been cultivated from an ancient species of emmer wheat (*Triticum dicoccoides* L.). Consuming the food items made of this spelt reduces the risk of contracting cardiovascular and some cancer diseases in humans due to the flour fiber content that is higher than that in other kinds of wheat. For the time being, this is one and the only variety of naked spelt available for agricultural growing and rich in protein, fibers, micro-and macroelements, and indispensable acids, which is typical for ancient kinds of wheat. Estimation of the spelt's biochemical, milling and baking properties have demonstrated the physical and chemical properties of the flour match those of first-class soft wheat. Our studies have shown that the flour made of the Grimme grains can be used to produce bakery products of higher biological, health-promoting, and nutrition value. These products are rich in manganese, selenium, zinc, potassium, Ferrum, phosphorus, vitamins B and D, and indispensable acids.

Keywords: Naked spelt, Aminoacids, Macro-and microelements, Baking properties, Health-promoting properties

Introduction

Emmer wheat is one of the oldest cereals associated with the Sumerian, Babylonian, ancient Israelite, and Greek civilizations (Zhuchenko, 2004). T. *dicoccoides* L. is the true wild emmer wheat with some domestication attributes, such as large ears and large vitreous high-protein grains. It grows in Northern Palestine and Syria and is considered the predecessor of T. *dicoccum* (Zhunchenko, 1971). Tetraploid emmer wheat cultivar *Triticumdicoccum* (*Schrank*) *Schuebl* or T. *turgidum* L. *ssp. dicoccoides (Koern) emend*. MK, as well as Ispahan emmer wheat (T. *ispahanicum* Helslot) cultivated in Iran since the early days, are grown alongside the ancient variations, such as Transcaucasian and Colchian emmer wheat. Similar to barley and oat crops, emmer wheat crops are collected as a grain-chaff mixture, i.e. unthreshed spikes that require further labor-intensive processing, which is why the latest variety Polba 3 was removed from a regionalization program in Russia in 1973.

It is also worth mentioning that despite the wide and successful use in developing soft and hard wheat bread, the emmer wheat itself has rarely been subjected to breeding programs.

Nowadays a rising interest in hulled wheat, such as emmer and spelt, can be seen in some Western European countries and the United States.

It has been reported that including these kinds of wheat into a diet reduces the risk of cardiovascular and some oncological diseases (Zhunchenko, 2004) due to relatively high fiber content in flours from ancient wheat varieties. Our personal experience also confirms the therapeutic properties of emmer wheat in oncological cases.

The absence of both domestic and foreign hulless emmer wheat varieties encouraged the authors of this paper (E.F. Ionov, A.F. Merezhko, S.K. Temirbekova, and N.E. Ionova) to develop the Grimme variety that was included in the State Register of Protected Breeding Achievements of the Russian Federation in 2012.

Grimme is a medium-ripe variation of the Taschkentum variety with a growing season of 85-100 days. In 2016–2019, protein contents in crops were 16.7-18.0%, and of crude gluten content - up to 47 %. The hulless emmer wheat variety is intended for making grits and bread. Grimme variety has high adaptive potential for a wide range of climate and soil conditions, i.e. is highly resistible against both biotic and abiotic stress factors of the respective regions. Also, the variety does not lose its nutritional quality, when grown in regions 2–7.

Grimme variety grits and flour are rich in trace elements, such as manganese, selenium, zinc, potassium, iron, phosphorus, group B and D vitamins, and essential amino acids (biochemical analysis performed at the Cherkizovo Center). The variety is resistant to drought, heat, and excessive wetting.

Sulukhan Temirbekova*, Irina Sardarova
All-Russian Research Institute of Phytopathology, Odintsovo, Bolshie Vyazemy, Institute street, 5, 143050, Moscow Region, Russia.

Yuliya Afanasieva, Ivan Kulikov
Federal Horticultural Center for Breeding, Agrotechnology and Nursery, 4, Zagor`evskaya Str., Moscow, 115598, Russia.

Marat Begeulov, Olga Beloshapkina
Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, 49, Timiryazevskaya Str., Moscow, 127550, Russia.

***Email:** sul20@yandex.ru

Immunological properties against several diseases, particularly against enzyme-mycotic depletion of seeds (EMDS) and the absolute resistance against some rust types and powdery mildew, have been proven (Ahmad, *et al.*, 2018; Ayah, *et al.*, 2018; Alduhisa, *et al.*, 2019; Yasin, *et al.*, 2020).

The variety is primarily recommended to children with allergic diseases, scoliosis, skin diseases, and hyperactivity (Temirbekova*et al.*, 2014).

The goal of the present research was to determine the physical, chemical, and milling properties of the Grimme variety hulless emmer grains, as well as the baking quality of emmer wheat flour.

Materials and Methods

The physical and chemical grain parameters were studied based on the following effective standards of analytical methods: the grain unit value was determined following GOST 10840-2017; the vitreousness – as per with GOST 10987-76; the crude gluten content and quality – as per GOST R 54478-2011 and GOST 27839-2013; the falling number – as per GOST ISO 3093-2016; the dough rheology – as per. Grains were milled into flour using the Melnic 100 Luks roller mill (output of 100 kg/h) capable of processing wheat grains into high-, first-, and second-grade flour. The grinding modes complied with the guidelines and procedures recommended for a shortened graded flour milling process at milling plants. Cold conditioning was used as the most common hydrothermal treatment technique. Emmer grains were initially moistened to moisture contents of 16.0-16.5 % and then humidified for 12 hours. Mechanical and kinematic parameters of rolls (roll space, corrugation spiral angle, corrugations per cm, corrugation pattern, the differential speed for the fast and slow rolls, and fast roll speed) and the set of sieves remained the same throughout the whole grinding process. The laboratory baking test complied with the state-level agricultural variety trial procedure developed by the All-Russian Center for Agricultural Variety Quality Assessment (VTsOKS).

The key disease monitoring method was to identify the smut disease during crop surveys at middle dough and complete ripeness stages. Here, 50–100 standing stems were tested in equal intervals (50-100 m) along the diagonal of the field over the area up to 100 ha at each trial site, and an additional sample of 100 stems was added from every other 25 ha area. All smut types were taken into account when analyzing the test bundles (Krivchenco, 1972).

EMDS were identified using the Temirbekova technique (Temirbekova, 1996, Temirbekova *et al.*, 2019).

In 2016-2018, the Grimme variety was grown in trial plots at the Centre of Gene Pool and Bio-Resources of Plants of the Federal Horticultural Center for Breeding, Agrotechnology and Nursery, at Field Testing Department Ramenki of the All-Russian Research Institute of Phytopathology, and on-plant locations in the Stupino and Odintsovo Districts of the Moscow Region.

Results and Discussion

Biochemical, immunological and physico-chemical properties of an ancient wheat grain – hulless spelt cultivar Gremme are investigated. Biochemical analysis of grain revealed a high content of protein, fiber, macro-and microelements, a rich composition of essential amino acids, which is characteristic of ancient wheat species. Evaluated milling and baking properties of spelt flour.

Physical and chemical parameters of spelt grain met the requirements for soft wheat grain class 1: the mass fraction of gluten-38.7 %, the nature of the grain-795 g / l, the number of drops-416 C, the total vitreousness-70 %. However, gluten had an increased stickiness, which is obviously due to the increased content of fiber and gliadin fraction. Grinding of spelt grain was carried out on the aggregate mill installation "Miller 100 Lux" to obtain baking flour of various cultivars.

The overall yield of flour of the first grinding was 59.7 %. The highest volume yield (359 cm^3) and the best organoleptic properties (total baking score – 3.6 points) were observed in a sample of bread baked from spelt flour that meets the requirements for wheat baking flour of the first grade.

Studies have confirmed the possibility of using flour produced from the spelt grain of the Gremme variety for the production of bakery products of increased biological, therapeutic and prophylactic, nutritional value and with a high organoleptic rating. Cereals and flour are very rich in trace elements-manganese, selenium, zinc, potassium, iron, phosphorus, vitamins from group B and B, essential amino acids (biochemical analysis was carried out by the Cherkizovo Center). The cultivar is resistant to drought, heat, excessive moisture.

Table 1 indicates the high biochemical parameters of the Grimme emmer wheat grown in the Moscow Region, in particular, the protein content of 18.05 % (on an air-dried basis), the crude gluten content of 1.8 %, and the contents of essential elements such as Mn, Fe, and Zn, of 55.5 to 87.5 %. The variety is also characterized by the rich composition of essential amino acids typical for ancient wheat species.

Table 1. Major and trace element composition of Grimme variety hulles emmer wheat, the average from 2017-2018.

№	Parameter	Measurement unit	Testing results	Testing results (adb)	Amino acid to protein ratio	Amino acid to protein ratio (adb)
1	2	3	4	5	6	7

0351/1	Humidity	%	7.89	-	-	-
	Crude gluten content	%	1.8	-	-	-
	Nitrogen content	%	2.92	3.17	-	-
	Protein content (conversion factor 5.7)	%	16.62	18.05	-	-
	Crude protein content (conversion factor 6.25)	%	18.22	19.79	-	-
	Manganese content	mg/kg	69.7	-	-	-
	Iron content	mg/kg	55.5	-	-	-
	Zinc content	mg/kg	87.5	-	-	-
	Copper content	mg/kg	5.3	-	-	-
	Threonine content	%	0.50	-	2.74	2.53
	Valine content	%	0.66	-	3.62	3.34
	Methionine content	%	0.28	-	1.54	1.41
	Leucine content	%	1.16	-	6.37	5.86
	Isoleucine content	%	0.54	-	2.96	2.73
	Phenylalanine content	%	0.85	-	4.67	4.30
	Lysine content	%	0.48	-	2.63	2.43
	Arginine content	%	0.70	-	3.84	3.54
	Tryptophane content	%	0.39	-	2.14	1.97
	Aspartic acid content	%	0.93	-	5.10	4.70
	Cystine and cysteine content	%	0.36	-	1.98	1.82
	Serine content	%	0.92	-	5.05	4.65
	Glutamic acid content	%	5.78	-	31.72	29.21
	Glycine content	%	0.63	-	3.46	3.18
	Alanine content	%	0.60	-	3.29	3.03
	Tyrosine content	%	0.50	-	2.74	2.53

Crude gluten content and quality is an essential parameter that determines the suitability of grain material for baking purposes. Based on this parameter and the others listed above, Grimme variety emmer grains qualify as the first-grade soft wheat grains, according to the effective standard. The crude gluten content in the grains was 36.7% given the first-grade quality (GD of 77 units), the dry gluten content - about 14.6%, and the hydration capacity - 152 %. At the same time, increased adhesiveness was observed after gluten washing possibly due to a high gliadin fraction content. It is established that hydrated glutenin is a rubbery, slightly extensible elastic mass with high stain resistance, whereas hydrated gliadin is a liquid, strongly extensible, viscous-flowing, sticky, nonelastic mass. Balanced composition allows crude wheat gluten to combine the rheological properties of both glutenin and gliadin fractions. Changes in compositions of gliadin fraction and individual glutenin subfractions in emmer grain gluten may have a significant effect on dough rheology and bread quality.

To determine whether the emmer grains are suitable for bread baking, they were milled in the modular Melnic 100 Luks roller mill to produce baking flours of various grades. Since the mill's process design only includes three systems, two break roll, and one reduction roll, in particular, emmer grains were milled in two passes as follows: the first pass to grind the initial emmer grains, and the second one to grind the product at the tail end of the second flour sieve # 38. Thus, four flour samples with different contents of endosperm, aleurone layer, and bran particles in the ground product were produced**.**

The flour yield after the first milling pass was 59.7 %. It then increased by 21.3 % after the second pass of the product at the tail end of the second flour sieve # 38.

In terms of whiteness, emmer flour sample #1 qualified as the first-grade flour (36 units according to RZ-BPL whiteness tester), while samples #2 and 3 qualified as second-grade (25.3 and 13.6

units, respectively). The second - pass products included a significant amount of ground husks, which had a significant effect on the whiteness. However, this fiber-rich flour may be of use in dietary and therapeutic food products. Crude gluten content in the produced flour samples varied from 22.6 to 43.7 % **(Table 2)**. Flour sample #1 compared favorably to the others in terms of crude gluten content (40.6 %) and quality (GD of 77 units). The falling number in the studied flour samples varied insignificantly at about 274-310 s, which satisfied the standard requirements for baking wheat flour.

Table 2. Gluten content and quality in emmer flour

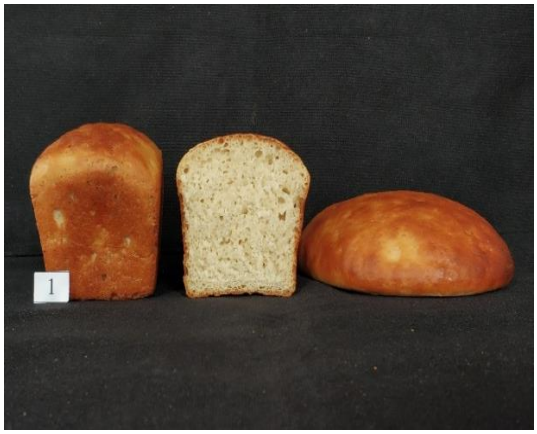
Flour samples	Crude gluten content, %	Crude gluten quality		Dry gluten content, %	Gluten hydration capacity, %
		GD units	Quality group		
#1	40.6	77	I	14.3	185
#2	43.7	105	III	15.3	186
#3	18.8	60	I	8.1	133
#4	11.6	49	II	4.9	137
LDS_{05}	1.7	8.8		0.4	5.9

Before the laboratory baking test, we used a farinograph to study the dough rheology. All dough samples were characterized by low resistance to mechanized mixing (1.5-2 min), high dilution (160-200 UF), and a low calorimetric value (39-52 units), matching dough quality parameters of weak wheat and filler wheat grains. The mixed dough was characterized by increased adhesiveness and quick dilution. Low dough rheology parameters of the emmer flour make it difficult to use in industrial processes and hurt the yield and organoleptic parameters of the baked bread. To perform a more unbiased study of the baking quality, a laboratory baking test was performed using a straight dough method prescribed for state-level agricultural variety trials.

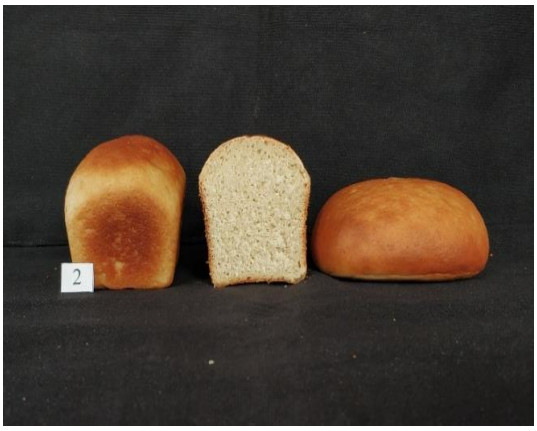
Sample №1 outperformed the other samples in bread yield by 34-121 cm^3 **(Figure 1, Table 3)**. Samples #1 and 2 demonstrated a slightly higher specific bread volume (2.6-2.8 cm^3/g) and general bread baking score on a scale from 1 to 5 (3.5-3.6). The bread samples received a high organoleptic score in terms of crust color (5), porosity (4-5), and flavor (5). The crust had an attractive gold-brown color, the bread crumbs had thin-walled, uniformly sized cells, and the flavor was pleasant and distinctive. Bread crumb humidity in the studied samples was 36.8-40 %, and the acidity was 3.5-4.7 degrees, which satisfied the standard requirements for baking wheat flour bread.

A decrease in gluten protein contents and an increase in contents of ground husk particles naturally lead to a decrease in bread yield and overall bread baking score. However, even the bread produced from flour samples #3 and 4 received satisfactory scores. It is worth noting that these bread samples have higher fiber, mineral, and vitamin contents, which may be of use in the healthy food industry.

The present study established the possibility of using the emmer flour produced from Grimme variety hulless emmer grains in production of the bakery products of high biological and nutritional value with high organoleptic scores. The further improvement of milling and bread baking processes for hulless emmer grains will make it possible to recommend emmer flour for wider use in the industry to enlarge the range of bakery goods for therapeutic and dietary purposes.

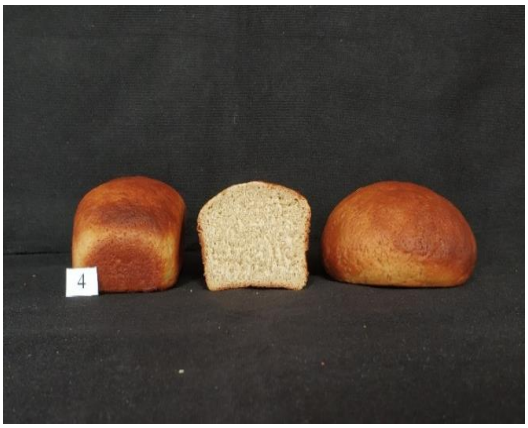


(a)



(b)

(c)



(d)

Figure 1. Bread samples produced from emmer flour: a) flour sample # 1, b) flour sample # 2, c) flour sample # 3,d) flour sample # 4

Table 3. Bread baking score chart

Flour sample	Hearth bread quality			Bread yield, cm^3	Specific volume, cm^3/g	Overall bread baking score
	Bread height (H), mm	Bread diameter (D), mm	Shape stability, H/D			
№1	42	117	0.36	359	2.8	3.6
№2	43	91	0.47	325	2.6	3.5
№3	42	89	0.47	287	2.4	3.1
№4	46	90	0.51	238	2.0	3
LDS_{05}				17.6		

The results of immunological studies in laboratory and field conditions showed the resistance of the Grimme variety to smut diseases. The variety is highly tolerant of enzyme-mycotic seed depletion (EMIS).

Biochemical analysis of the grains revealed high contents of proteins (ADB) and essential amino acids, as well as a rich major and trace element composition.

It was found that the grains satisfy the standard requirements for the first-grade soft wheat grains based on the observed quality parameters.

Given the high crude gluten content (36.7 %) and the first-grade quality (GD of 77 units), the excessive gluten adhesiveness (due to high fiber content) and low emmer flour dough rheology limit the volumetric yield of bakery products (238-359 cm^3). Despite that, the bread samples received high organoleptic scores, had attractive crust color, and excellent flavor.

To widen the range of bakery products of high nutritional, therapeutic, and biological value, we may recommend a further study of the use of Grimme variety hulless emmer grains for baking flour production.

Conclusion

The performed field and laboratory immunological studies have confirmed the Grimme variety is resistant to the dangerous diseases that develop in grain crops, and the spelt grain's quality parameters meet the first-class soft wheat requirements.

Biochemical analysis of the grain's properties has shown that it has high protein content on a dry basis and is rich in indispensable acids and macro-and microelements. The high wet gluten content (36.7 %) and its excessive stickiness in the grain of the first quality group (77 FDM units) significantly reduce the risk of cardiovascular and some cancer diseases. The bread baked from the flour is of excellent taste.

Acknowledgments: None

Conflict of interest: None

Financial support: None

Ethics statement: None

References

Ahmad, M. S., Shawky, A., Ghobashy, M. O., & Felifel, R. H. A. (2018). Effect of Some medicinal plants on life cycle of Citrus Brown Mites (Eutetranychusorientalis). *International Journal of Pharmaceutical Research & Allied Sciences, 7*(4), 13-17.

Alduhisa, G. U., & Demayo, C. G. (2019). Ethnomedicinal plants used by the Subanen tribe in two villages in Ozamis City, Mindanao, Philippines. *Pharmacophore, 10*(4), 28-42.

Ayah, B., Sara, M. N., & Shimaa, R. (2018). Decontamination of Eggshell Contaminated with Salmonella Typhimurium Using Natural Plant Extracts. *International Journal of Pharmaceutical Research and Allied Sciences, 7*(3), 10-19.

Krivchenko, V. I. (1972). Justification of methods for accounting smut in cereals. *Mycology and Phytopathology, 6*(4), 351-354. (In Russian)

Temirbekova, S. K., Ionov, E. F., Ionova, N. E., & Afanaseva, Y. V. (2014). Using of wheat ancient species to boost children's immune system. *Евразийский Союз Ученых*, (5-6).

Temirbekova, S. K., Ovsyankina, A. V., Ionova, N. E., Cheremisova, T. D., Afanasyeva, Y. V., Mitrofanova, O. P., & Al-Azawi Nagham, M. H. (2019). Enzymatic activity in the resistance stress of winter wheat from different sources in the Non-black land of the center of Russian Federation. *Plant Archives, 19*(1), 1653-1658.

Temirbekova, S. K. (1996). Diagnostics and assessment of cereal

crop varieties' resistance to enzyme mycotic depletion of seeds (EMDS). Methodical guidelines. – Moscow: Rosselkhozakademiya, p.115. (In Russian)

Yasin, G., Ahmad, M., & Hussain, M. (2020). Pharmacological Potential of Plants from Himalyan Region of Pakistan-Assay for Antioxidants Indices. *Pharmacophore, 11*(3), 82-88.

Zhukovsky, A. A. (1971). Cultivated plants and their wild relatives. Taxonomy, geography, cytogenetics, ecology, origin, utilization. Leningrad, Kolos. Ed. 3,p. 752. (In Russian)