

²WHEAT

W H O L E G R A I N P R O T E I N C O N C E N T R A T E

PRODUCT DESCRIPTION :

Wholegrain protein concentrate (²WHEAT) utilises complex grain-processing technology to produce nutritional and unique products.

The production process begins by using specialised equipment to clean the grain's exterior while protecting and maintaining the nutrients inside. Impurities such as straw, dust, stones, and microbiological contamination are removed.

Then, the grain is turned into a flour that is rich in carbohydrates, proteins and fiber. The flour is mixed with water and the resulting mass is fermented under tightly controlled conditions.

After fermentation, the carbohydrates are removed through the use of an advanced centrifugal system but the fiber, protein, vitamins, and other valuable ingredients are maintained. Under specific conditions (by controlling the temperature and physicochemical performance of intermediate products), a technological process transforms the bulk of the fiber and protein into pellets. Finally, the pellets are crushed into a powder and carefully packed.

²WHEAT is a product with its own unique properties, which are observed through physicochemical, nutritional, and sensory indicators.



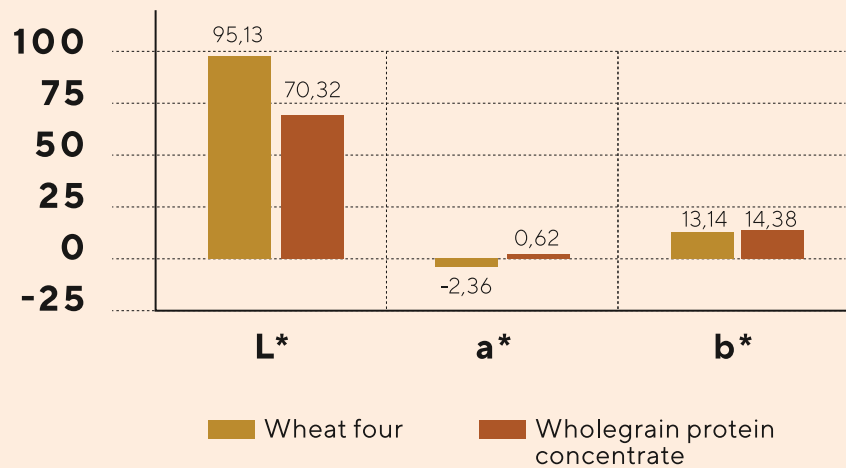
Figure 1. ²WHEAT powder

PRODUCT APPEARANCE – COLOUR :

The product is light beige due to the characteristic colour of the raw material (grain) and the process by which it is obtained. The product's beige colour is affected by the partial denaturation of proteins that takes place during the manufacturing process. The light colour is influenced by the size of the fraction – the finer the fraction, the lighter the powder looks. However, when the product is in contact with liquid, its colour darkens and the size of the fraction no longer matters. Discolouration also occurs when the product comes into contact with other raw materials.

PRODUCT FORM :

A free-flowing powder with an expressive fraction due to its rich fiber content and partially denatured proteins.



1. Table 2WHEAT colour comparison with high-quality wheat flour

PRODUCT SMELL:

The smell of the product is relatively neutral with pleasant, lightly roasted notes. The smell varies depending on temperature — as the temperature rises, the product will develop a slightly acidic aroma as a result of the fermentation process.

PRODUCT TASTE:

The product has a slightly acidic taste, similar to naturally fermented rye bread. The acidity is more pronounced at higher concentrations and temperatures.

Indicator	Measurement	Results	Explanations
Product fraction	mm	Fine (ground into powder after production)	-
Colour	Sensory	Light, beige	The beige colour is characteristic of the raw material (grains) and the process by which it is obtained (during which partial protein denaturation takes place).
Smell	Sensory	Neutral, but you can feel a slightly sour aroma under the influence of increased temperature	The slightly acidic aroma is due to the fermentation process from which the product is obtained
Taste	Sensory	Slightly acidic, similar to naturally fermented rye bread — the acidity of the product is more pronounced in the aftertaste.	This is explained by the fact that the product is obtained by fermentation.

2. Table 2WHEAT evaluation of external appearance.

PRODUCT PHYSICO-CHEMICAL INDICATORS:

Moisture is an essential indicator for any product as it can affect the taste, consistency, appearance, and shelf-life of a product. Moisture is the amount of water present in a food product, expressed as a ratio ranging from 0 (completely dry) to the product's porosity value at saturation.

²WHEAT has a moisture content of around 6%, which is considered low (below the threshold of 10%), and therefore the product can be considered safe and with long shelf-life as it is unlikely to develop microorganisms (bacteria, fungi).

A product's pH value characterizes the concentration of hydrogen ions (H⁺) it has in a solution – an important factor in various chemical processes for food products. pH values range from 1 to 14 (pH < 7 = acidic, pH > 7 = alkaline, pH is 7 = neutral).

The pH of ²WHEAT is around 4 (acidic) which compounds its safety as there is a low likelihood of microorganisms developing.

Water activity (a_w) describes the water available for microbial growth and is a good indicator of food safety and how long a food product will be valid for consumption. a_w values range from 0 to 1. The closer the value is to 0, the lower the water activity.

²WHEAT's a_w is around 0.4. This is considered low and indicates that the product is unlikely to develop microorganisms (providing suitable packaging and storage conditions are met). As a result, the possibility of spoilage is low and the product's shelf-life will be prolonged.

Indicator	Measurement	Results	Explanations
Moisture	%	6	Low levels of moisture, pH, and water activity ensure that microorganisms, such as yeasts and moulds, are less likely to develop – which is important for ensuring the product's long shelf-life.
pH	n	4	
a _w	n	0,4	
Acid number and free fatty acids (FFA)	mg KOH/g	49.2	Comparatively, this indicator is 5.4 for cornmeal, 3.8 for wheat flour, and 13 for milk.
Water-binding capacity	%	75	Comparatively, this indicator is 83% for cornmeal and 89% for wheat flour.

3. Table ²WHEAT evaluation of physical indicators.



Figure 2. ²WHEAT powder in different fractions

PRODUCT MICROBIOLOGICAL INDICATORS:

Indicator	Maximum Values	Measurement	Method	Results
Number of micro-organisms (MAFAM)	100000	CFU (colony-forming units) / g	PC-Agar, 30°C, 72 h	5000
Moulds	1000	CFU (colony-forming units) / g	YGC-Agar, 25°C, 4 days	50
Yeasts	1000	CFU (colony-forming units) / g	YGC-Agar, 25°C, 4 days	50
Salmonella	Negative	CFU (colony-forming units) / 25 g	DIN EN ISO 6579-1	Negative
Escherichia coli	Negative	CFU (colony-forming units) / g	DIN ISO 16649-2:2009-12	Negative

4. Table ²WHEAT microbiological indicators.

PRODUCT NUTRITIONAL AND ENERGY VALUE:

²WHEAT is a high-quality product with low levels of carbohydrates (6.7 g per 100 g-1), sugars (2.5 g per 100 g-1), and fats (7.8 g per 100 g-1), while maintaining high levels of protein (62 g per 100 g-1) and fiber (17 g per 100 g-1) – vital daily nutrients that act as the basis of a faster satiety ensuring and balanced diet.

Maximum Values	Measurement	Results
Energy value	kJ / kcal	1584 / 377
Fat	g	7.8
Including:		
Saturated fatty acids	g	1.9
Carbohydrates	g	6.7
Including:		
Sugars	g	2.5
Fiber	g	17
Protein	g	62
Salt	g	0.01

5. Table ²WHEAT nutritional value.

According to the EC Regulation, the recommended daily intake (RDI) of protein is 50 g and the RDI of fiber is an average of around 10 g per 1000 kcal (taking into account a ratio of 3:1 insoluble and soluble fiber). ²WHEAT's protein content is 62 g per 100 g-1, including all the essential amino acids, and the fiber content is 17 g per 100 g-1. Since ²WHEAT contains a lot of protein and fiber, it has its own unique sensory — the optimal amount for use in its pure form would be 20 g, fulfilling 40% of the protein RDI and 34% of the fiber RDI.



Figure 1. ²WHEAT powder

Amino acid	Indicator, g 100 ⁻¹	Method
Ala	2	REG(EC) 152/2009, III, F : 2009-02
Arg	2.43	
Asp	2.69	
Cys	1.28	
Gly	2.21	
Glu	19.6	
Pro	6.39	
Ser	2.85	
Tyr	1.89	

Amino acid	Indicator, g 100 ⁻¹	Method
Leic	4.18	REG(EC) 152/2009, III, F : 2009-02
Phe	3.04	
His	1.29	
Izol	2.28	
Lys	1.33	
Met	0.98	
Treon	1.76	
Val	2.7	

6. Table ²WHEAT amino acid composition.

PRODUCT VITAMIN
PROFILE :

Our energy levels, brain function, immune system, eyesight, digestion, nerve function, muscle tone, and cardiovascular health all require vitamin B.
Like other wholegrain products, ²WHEAT is a good source of B group vitamins and provides 30% of the RDI in a 100 g serving. ²WHEAT is also a source of vitamin B12, providing 20% of the RDI in a 100 g serving.

PRODUCT
DIGESTIBILITY :

²WHEAT has a high protein content (62 g per 100 g-1) and 30% of these protein types are digested by the stomach and intestines.

PRODUCT SOLUBILITY (INTERACTION WITH VARIOUS
SOLVENTS AND LIQUIDS / FOOD PRODUCTS) :

Liquid foods form different interactions when they come in to contact with powdered foods — there are a variety of different solubility, mixing, swelling, stratification, physical, and sensory indicators. Since ²WHEAT is a protein concentrate, and consumers generally mix these with dairy products or juices, it is important to understand how the product interacts with various liquids.

During the production process of ²WHEAT, some of the proteins are denatured and encapsulated. As a result, the product's solubility and swelling capacity changes — the high fiber content affects its density and has a significant effect on the layering speed, layer thickness, and sensory sensation.

Solvents:	pH for raw materials (solvents)	pH solvent + ² WHEAT	stratification rate	stratification, solid particle layer thickness, cm	Solubility	² WHEAT particle size / structure	² WHEAT sensing of particles after contact with the solvent
Water (20 degrees)	7.00	4.32	Very fast – 1	2	does not dissolve	² WHEAT swells and becomes soft	taste like soaked, swollen rye bread
Water-boiling (100 degrees)	7.00	4.32	Very fast – 1	2	does not dissolve	² WHEAT swells and becomes soft	taste like soaked, swollen rye bread
Oil	6.81	4.04	Slow – 3	1.1	partially soluble	² WHEAT partially dissolves and this part forms a homogeneous mass, while the other part of ² WHEAT does not swell and forms a layer of solid particles at the bottom of the container	the hard fiber particles that irritate the throat like sand, the taste is oily, this part alone is not enjoyable
Milk - cow 2.5%	6.68	5.13	Medium fast – 2	2.1	partially soluble	² WHEAT swells and becomes soft, soft structure	² WHEAT goes well with milk to taste, it develops a mild taste
Milk - vegetable - oat - self-made	6.78	4.38	Slow – 3	2.3	does not dissolve	² WHEAT swells and becomes soft, soft structure	² WHEAT goes well with oat milk in terms of taste, only the taste is a little more sour than with cow's milk
Milk - vegetable - rice-almond - shop bought	6.62	4.49	Very slow – 4	N	does not dissolve	² WHEAT swells and becomes soft, soft structure	² WHEAT goes well with rice-almond milk according to taste, the taste is sweet and sour, because plant milk contains sugar
Kefir 2.5%	4.41	4.32	Does not happen	N	partially soluble	² WHEAT swells and becomes soft, but the particles are harder than milk-ripened	very sour in taste, additional raw materials are needed to neutralize the acid
juice-orange	3.87	4.00	Slow – 3	2.5	does not dissolve	² WHEAT swells and becomes soft	refreshing sour taste with a distinct orange flavor
juice-apple	3.59	3.89	Medium fast – 2	2	does not dissolve	² WHEAT swells and becomes soft	balanced, briskly sweet and sour taste, tasty and enjoyable

7. Table ²WHEAT solubility evaluation.

PRODUCT INTERACTION WITH OTHER RAW MATERIALS:

²WHEAT is rich in protein and fiber. Therefore, by adding it to other raw materials, the resulting product is enriched with protein and fiber.

²WHEAT can supplement foods with protein and fiber when these nutrients do not naturally occur in high numbers. As a result, the foods can be considered rich in protein and fiber in accordance with the EC Regulation.

For example, when you add ²WHEAT to flour products, changes are visible both in the cooking process and the finished product. The colour tends to get darker due to the difference in colour between wheat flour (the main colour determinant) and ²WHEAT. The degree of darkening in flour products is determined by the concentration of ²WHEAT and its fraction – the more ²WHEAT added, the darker the colour will be; and the finer the ²WHEAT fraction, the more evenly it will be distributed over the flour, producing a more even tone.

However, this colour-darkening effect is generally positive because consumers associate the appearance with healthy wholegrain flour.

When technologically evaluating the effect of ²WHEAT on the formation of flour dough, a change in the structure of the dough can be observed. The dough has a particular surface structure due to its rich fiber content and partially denatured proteins. Doughs with smaller concentrations (5 – 10% depending on the type of product) form a more porous and voluminous product, but larger additions of ²WHEAT produce a denser and darker colour dough.

²WHEAT can be added to various products, including flour products, extruded products, sugar confectionery, dairy and sour-milk products, vegan and vegetarian products, and specialized products (e.g. products for athletes, high-intensity training, tourism, etc.). However, each product has a slightly different concentration of ²WHEAT.

Product	References SOURCE OF PROTEIN and HIGH PROTEIN	References SOURCE OF FIBER and HIGH FIBER	Recommended amount of 2WHEAT according to studies
WHITE BREAD	In order to use the "HIGH PROTEIN" nutrition claims, it is necessary to replace 15% of the total amount of flour with 2WHEAT.	In order to use the "HIGH FIBER" nutrition claims, it is necessary to replace 18% of the total amount of flour with 2WHEAT, or 16% of all raw materials (excluding water).	The optimal content of 2WHEAT by physical and sensory indicators is 15 – 20% of the total amount of flour.
RYE BREAD – SENČU	In order to use the "HIGH PROTEIN" nutrition claims, it is necessary to replace 12% of the total amount of flour with 2WHEAT.	The addition of 2WHEAT does not affect the "HIGH FIBER" claim.	NOT STUDIED
RYE BREAD – KLASISKĀ	In order to use the "HIGH PROTEIN" nutrition claims, it is necessary to replace 15% of the total amount of flour with 2WHEAT, or 13.5% of all raw materials (excluding water).	The addition of 2WHEAT does not affect the "HIGH FIBER" claim.	NOT STUDIED
SWEET AND SOUR BREAD	In order to use the "HIGH PROTEIN" nutrition claims, it is necessary to replace 16% of the flour with 2WHEAT, or 13% of all raw materials (excluding water).	The addition of 2WHEAT does not affect the "SOURCE OF FIBER" claim, but by adding enough 2WHEAT to achieve the "HIGH PROTEIN" nutrition claims, the fiber content will increase to the point at which the "HIGH FIBER" nutrition claims may also be used.	NOT STUDIED
CRACKERS	In order to use the "SOURCE OF PROTEIN" nutrition claims from the EC Regulation, 2WHEAT must be 8% of the total flour content or 6% of all raw materials (excluding water). To use the "HIGH PROTEIN" nutrition claims, it is necessary to replace 29% of the total amount of flour with 2WHEAT, or 22% of all raw materials (excluding water).	The addition of 2WHEAT does not affect the use of the "SOURCE OF FIBER" claim.	The optimal content of 2WHEAT by physical and sensory indicators is 10% of the total amount of flour.
PASTA	In order to use the "HIGH PROTEIN" claim in the EC Regulation, it is necessary to replace 12% of the total amount of flour with 2WHEAT.	In order to use the "HIGH FIBER" nutrition claims, it is necessary to replace 15% of the total amount of flour with 2WHEAT.	The maximum content of 2WHEAT by physical and sensory indicators is 20% of the total amount of flour.

Product	References SOURCE OF PROTEIN and HIGH PROTEIN	References SOURCE OF FIBER and HIGH FIBER	Recommended amount of 2WHEAT according to studies
CUPCAKES	In order to use the "SOURCE OF PROTEIN" nutrition claims in the EC Regulation, it is necessary to replace 30% of the total amount of flour with 2WHEAT.	In order to use the "SOURCE OF FIBER" claim in the EC Regulation, it is necessary to replace 30% of the total amount of flour with 2WHEAT.	The optimal content of 2WHEAT by physical and sensory indicators is 5 – 10% of the total amount of flour.
BUTTER BISCUITS	In order to use the "SOURCE OF PROTEIN" nutrition claims in the EC Regulation, it is necessary to replace 18% of the total amount of flour with 2WHEAT.	In order to use the "SOURCE OF FIBER" claim in the EC Regulation, it is necessary to replace 18% of the total amount of flour with 2WHEAT.	The optimal content of 2WHEAT by physical and sensory indicators is 15% of the total amount of flour.
BREAKFAST CEREALS	In order to use the "SOURCE OF PROTEIN" nutrition claims in the EC Regulation, the 2WHEAT content of the total raw material must be 12.5%. To use the "HIGH PROTEIN" nutrition claims, the 2WHEAT content should be increased to 24%.	If 24% of the flour is replaced by 2WHEAT, the "HIGH PROTEIN" nutrition claims may be used. With this proportion, the fiber content will increase too and the "HIGH FIBER" indication may also be used.	The optimal content of 2WHEAT by physical and sensory indicators is 12% of the total amount of flour.
PROTEIN BARS	In order to use the "HIGH PROTEIN" nutrition claims, 2WHEAT must make up 12% of all raw materials.	The addition of 2WHEAT does not affect the use of the "HIGH FIBER" claim.	The optimal content of 2WHEAT by physical and sensory indicators is 12% of all raw materials.

8. Table . 2WHEAT optimal dosage in flour products and the effect of adding 2WHEAT on the nutrition claims used for flour products

In the finished product, you will see significant differences in volume, colour and, of course, nutritional value. For example, by replacing 5 – 10% of the flour with 2WHEAT, the volume of bread increases (with 5% 2WHEAT) or is equivalent to the control (with 10% 2WHEAT).

When the concentration of 2WHEAT is more than 10% of the total mass of flour, the bread's volume will reduce significantly – however, this would have an extremely beneficial overall effect on the nutritional value of the product.

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