

²WHEAT

Application -
CEREALS

HIGH-QUALITY WHOLE GRAIN PROTEIN CONCENTRATE -

produced from non-GMO wheat grains grown in the Baltics, EU origin, rich in fiber, after fermentation.

Moisture, % - 6	Protein composition in the product - 60-65%	Dietary fiber composition in the product - 17%
	Water activity (a_w) - 0.434	Contains all essential amino acids
pH - 4.01		Total amount of amino acids - 60%



Corn is the most popular raw material for making extruded products and corn flour is used as the basic raw material due to its good taste and rheological properties. Corn flour has a protein content of 6-10% and changes in corn protein during extrusion are similar to wheat gluten, so in the study with ²WHEAT, a sample made from corn flour and corn starch in the same ratio of 1:1 or 50% and 50% was used as a control sample. When evaluating the extrusion process, ²WHEAT affected that extrusion could be done at lower temperatures, because ²WHEAT is made from wheat, but it is not recommended to extrude wheat at high temperatures, because high temperatures can cause chemical changes in the protein such as complete denaturation and the formation of Maillard compounds (acrylamide) in large amounts that can lead to the loss of certain amino acids, which adversely affects the nutritional value of the product. As products with ²WHEAT can be extruded at lower temperatures, this is also positive from the point of view that there is less negative effect on vitamins, especially Vitamin B1 (thiamine), which is more thermosensitive, while Vitamin B2 (riboflavin) and Vitamin B3 (niacin) shows high resistance to extrusion conditions and therefore its quantity does not change significantly in this process.

In order for extruded products made from corn to have a higher nutritional value, they can be enriched with whole grain protein concentrate ²WHEAT, the amount of which in the product to be called a "source of protein" according to the EC regulation is 12.5% of the total amount of raw materials, replacing part of corn flour, but for the product to have "high protein" - the ²WHEAT content should be 24% of the total amount of raw materials, replacing the part of corn flour.

Physico-chemical parameters: the extruded products with ²WHEAT, it can be seen that the addition of ²WHEAT does not significantly affect the moisture and all products have a moisture content within 5%. On the other hand, the pH decreases when ²WHEAT is added, which is in accordance with the characteristics of ²WHEAT - the pH of ²WHEAT is 4.01, and the pH of cornmeal is 6.17. The water activity (a_w) of all extruded products is relatively low, which is typical for this type of product, and the raw material ²WHEAT itself also has a low water activity of 0.434, which is a favorable aspect so that the product does not spoil quickly and has a long shelf life.

Physical parameters: The physical parameters of extruded products with added ²WHEAT such as mass, bulk density, shape and volume of the extruded product can be characterized as equivalent to extruded products from corn only (control sample) with very small, insignificant changes shown by the measurements in table, which means that ²WHEAT together with corn, it is well suited for obtaining extrudate products.

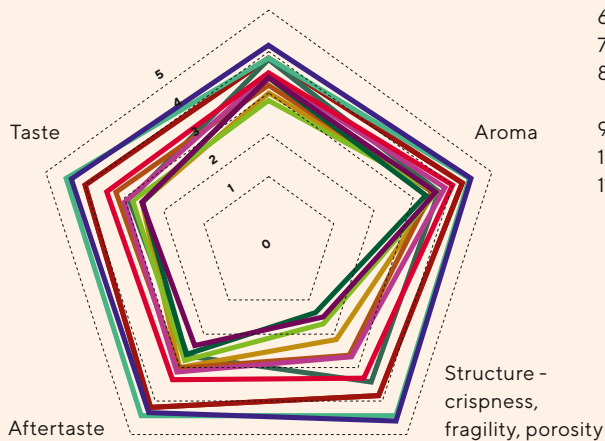
Samples	Moisture, %	pH	a_w	Mass, g	Bulk density	Dimensions for 1 unit, length x width, mm	Shape
Control (CF+CS)	5.2	5.91	0.3851	12.21	porous	11x10	rounded
12,5% ² WHEAT	5.4	4.55	0.4425	11.03	equivalent K	10x9	rounded, visible cut line of the extruder knife
24% ² WHEAT	4.8	4.20	0.4225	12.10	equivalent K	11x10	rounded, visible cut line of the extruder knife

C-control, CF-corn flour, CS-corn starch, ²WHEAT - Whole grain protein concentrate



SENSORY EVALUATION OF CEREALS

Visual appearance - color, shape



1. C (Control)- corn flour (CF) + corn starch (CS)
2. Corn flour (CF) + Pea starch concentrate (PS) + Pea protein isolate (PP) + ²WHEAT (25%)
3. Corn flour (CF) + Pea starch concentrate (PS) + Gluten (GL) + ²WHEAT (25%)
4. Rice flour (RF) + Pea starch concentrate (PS) + Pea protein isolate (PP) + ²WHEAT (25%)
5. Rice flour (RF) + Pea starch concentrate (PS) + Gluten (GL) + ²WHEAT (25%)
6. Corn flour (CF) + Pea protein isolate (PP) + ²WHEAT (20%)
7. Corn flour (CF) + Corn starch (CS) + Pea protein isolate (PP) + ²WHEAT (20%)
8. Corn flour (CF) + Corn starch (CS) + Pea protein isolate (PP) + Pea protein (PPyellow) + ²WHEAT (20%)
9. Corn flour (CF) + Pea starch concentrate (PS) + Pea protein (PPyellow) + ²WHEAT (20%)
10. Corn flour (CF) + Potato starch (POTS) + Gluten (GL) + ²WHEAT (20%)
11. Corn flour (CF) + Corn starch (CS) + Gluten (GL) + ²WHEAT (20%)

- 1 Control CF+CS
- 7 CF+CS+PP+20% ²WHEAT
- 2 CF+PS+PP+25% ²WHEAT
- 8 CF+CS+PP+PPyellow+20% ²WHEAT
- 3 CF+PS+GL+25% ²WHEAT
- 9 CF+PS+PPyellow+20% ²WHEAT
- 4 RF+PS+PP+25% ²WHEAT
- 10 CF+POTS+GL+20% ²WHEAT
- 5 RF+PS+GL+25% ²WHEAT
- 11 CF+CS+GL+20% ²WHEAT
- 6 CF+PP+20% ²WHEAT

Samples	Moisture, %	pH	a _w	Structure (hardness), N	Number of peaks, pcs.	Mass, g	Bulk density	Dimensions for 1 unit, length x width, mm	Shape
1 Control	4.9	6.00	0.3798	166.701	320.5	7.71	1. (the largest)	21x13	rounded
2	5.6	5.84	0.4939	968.798	175.67	16.41	3. reduced volume compared to C	11x7	rounded
3	6.5	5.35	0.4331	ND	ND	32.18	reduced volume compared to C	6x4	spur
4	5.1	5.89	0.5392	ND	ND	24.32	reduced volume compared to C	7x5	rounded
5	5.8	5.30	0.3964	ND	ND	33.18	reduced volume compared to C	9x4	spur
6	5.5	5.96	0.3523	ND	ND	18.01	4. reduced volume compared to C	8x6	rounded
7	5.0	5.89	0.3879	718.653	207.33	15.43	2. reduced volume compared to C	12x8	rounded
8	5.1	5.88	0.3895	ND	ND	25.33	reduced volume compared to C	7x4; 5x3	rounded
9	5.5	5.84	0.4561	874.896	201.33	26.01	reduced volume compared to C	7x4; 6x4	rounded
10	5.6	5.22	0.3549	ND	ND	32.37	reduced volume compared to C	9x4	spur
11	5.6	5.05	0.3239	ND	ND	31.05	reduced volume compared to C	10x4	spur

ND - not detectable; C - control

Physical parameters: The physical parameters of the extruded products from different raw materials with added ²WHEAT, such as mass, bulk density, shape and volume of the extruded product, can be characterized as very different, which is shown by the research results, which means that attention should be paid to the selected raw materials to match it with the desired result.

The samples with added gluten formed products with a very dense structure, which means that they had a high hardness and would not be suitable for making breakfast cereals, however, they can be used for a type of product such as snack straws. In order to prepare breakfast cereal with a very high protein content, the most suitable combination of raw materials is with peas - experiment sample 6, picture 8.

When evaluating the extruded product made from different raw materials and added ²WHEAT, the results are shown in Table. Sensory evaluation of extruded products from different raw materials with ²WHEAT, the ability of consumers to accept the presence of ²WHEAT is observed - consumers rated the presence of ²WHEAT as acceptable and in some samples as pleasant. The slightly sour taste of some samples works well with starches, but ²WHEAT does not work so well with gluten and pea isolates due to the hard texture. The aroma of all samples is formed neutral.

2. sample-specific taste and unpleasant aftertaste; Samples 3, 5, 10 and 11 have poor structure, dissolve in the mouth. the 6th and 7th was the best. and sample 9, they are samples with a good structure and are pleasant to eat, the most neutral taste, are crunchy.

Physico-chemical parameters: Evaluating the physical parameters of the extruded product from different raw materials with added ²WHEAT, small differences are visible, however, they are not drastic: the moisture in the extruded products varies between 4.9 and 6.5%, the pH changes with a slight decrease in the value - the control value is 6.00, which is ²WHEAT addition result (for samples with added ²WHEAT the pH value is in the range of 5.96 to 5.05).

On the other hand, the water activity of these products is low, which is a positive aspect for the product, so that it does not spoil quickly and has a long shelf life.

The structure of extruded products from different raw materials with added ²WHEAT is very different and their application would therefore be different. It was possible to measure the hardness of the products using the classic method only for the control and samples 2, 7, 9, whose structure was more fragile and the hardness was not so high.

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