

## USE OF SECONDARY RAW MATERIAL OF ANIMAL PRODUCTS IN THE TECHNOLOGY OF PRODUCTION OF BAKERY PRODUCTS BASED ON WHEAT-AMARANTH MIXTURE

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Received: October, 03, 2018

Accepted: June, 20, 2019

**Abstract:** Amaranth refers to promising raw ingredients, enriching bakery products. In this work we deal with such kind of seeds as "Polet". It is one of Saratov selection. Curd whey is well known not only as a good enricher, but also as an effective bread improver. The comparative analysis of the effect of secondary raw materials of livestock products (whey from cow and goat milk) on the quality of wheat-amaranth bakery products was made. The results of the research made us think that it is better to use goat's milk whey in the technology of bakery products from wheat-amaranth flour to give them functional properties.

**Keywords:** *amaranth, fermenting activity, lifting force, whey, wheat flour*

## INTRODUCTION

Natural milk whey according to GOST R 53438-2009 "Milk whey" is a secondary product of milk processing for cottage cheese, rennet cheese and casein.

The main component of dry substances in milk whey is lactose, the mass fraction of which is more than 70 % of whey solids. The main feature of lactose is its slow hydrolysis in the intestine, in connection with which, the fermentation processes are limited, the vital activity of the useful intestinal microflora is normalized, the putrefactive processes and gas formation are slowed down [1 – 7].

The protein content in milk whey depends on the way of coagulation of milk proteins, taken in the production of the main product. Whey proteins contain more essential amino acids in their composition than casein, are high-grade proteins that are used by the body for structural metabolism, mainly for the synthesis of liver proteins, hemoglobin and blood plasma formation.

Such composition of milk and the biological properties of whey make it possible to refer them to valuable industrial raw materials, which can be used in various food industries and other field [8, 9]. Protein substances of milk whey are close in nature to blood proteins, therefore they are used by the human body for regeneration of liver proteins, hemoglobin and blood plasma formation. Whey proteins contain a large number of essential amino acids, in addition, they have an anti-carcinogenic effect, they also make the body's immune system stronger. The chemical composition of whey allows using it as a source of mineral substances, vitamins, easily digestible proteins [10, 11].

Natural milk whey is used in the production of bread and bakery products from wheat flour [12 – 16].

The use of whey is very good not only to improve the quality of bread and bakery products, but also to intensify the process of dough formation if we need a faster way to make bread.

Whey enriches bread and bakery products with essential amino acids, especially with tryptophan and lysine, as well as calcium and phosphorus. At the same time, the output of bread increases, its quality improves, and the nutritional value increases. Duration of cooking bakery products is reduced. Bread gets a pleasant taste and aroma like fermented milk products, bread crumb gets fine and soft. The development of technology for the production of bread with the use of whey for therapeutic and dietary nutrition is very topical today, because it is aimed to solve the national problem - the health of nation.

In recent years a new source of raw materials for the food industry - amaranth seeds and products of it is processing. They have a valuable chemical composition and safety, high food and biological value, contain a wide range of physiologically functional food ingredients has appeared on the world market, which determines the prospects for their use in food technology productions [17 – 20].

The purpose of our work is to study the influence of various milk whey on the quality of bakery products based on wheat - amaranth mixture.

To achieve the goal, the following tasks were set:

1. To assess organoleptic quality of various types of whey.
2. To investigate the fermenting activity and lifting force of test billets with whey from cow and goat milk based on wheat flour and wheat-amaranth mixture.
3. To study the influence of various milk whey on the quality of final bakery products.

## MATERIALS AND METHODS

In the research we used amaranth flour from Amaranth seeds of such kind as «Polet», wheat flour of the highest grade of the trade mark "Ruble berezhet" (GOST R 52189-2003), curd whey from cow and goat milk.

Organoleptic properties of flour (color, smell, taste and crunch) were determined according to GOST 27558, the mass fraction of moisture (%) - by drying in the drying oven SESH-3M according to GOST 9404, titratable acidity (grad) - according to GOST 27493, mass content (%) and the quality (standard unit IDK-1) of crude gluten of composite flour - according to GOST 27839. The whiteness of the investigated types of flour was determined on a special device "Blik-R3". Organoleptic properties of whey were determined according to GOST R 53438-2009.

Organoleptic properties of a bakery product were determined in accordance with GOST 27844; Mass fraction of moisture (%) - by drying in the drying oven SESH-3M according to GOST 21094-75; porosity of crumb (%) - according to GOST 5669-96; titratable acidity (grad) - according to GOST 5670-96.

## RESULTS AND DISCUSSION

Amaranth seeds, previously cleaned of impurities, on an air-sieve separator, washed in a washer and dried on a shaker, were ground on a laboratory roll mill "Kvadrumat Junior" by Brabender. The data obtained on the quality of flour from amaranth seeds are given in Table 1.

*Table 1. Characteristics of flour from seeds of amaranth "Polet"*

The name of indicators	Characteristics and value of indicators
Color	Light cream
Whiteness, un. of the device "Blick-R3"	33
Smell	Characteristic of flour from amaranth, without extraneous smells
Flavor	Characteristic of amaranth flour, without foreign flavors, not sour, not bitter
Content of mineral impurities	Crunch absent
Infection and contamination by pests of grain stocks	Not detected
Humidity, [%]	11.8
Acidity, [degree]	8.5
Water absorption capacity (UPU), [%]	48

The determination of organoleptic parameters was performed visually and organoleptically at a whey temperature ( $22 \pm 2$  °C) (Table 2).

*Table 2. Organoleptic parameters of milk whey*

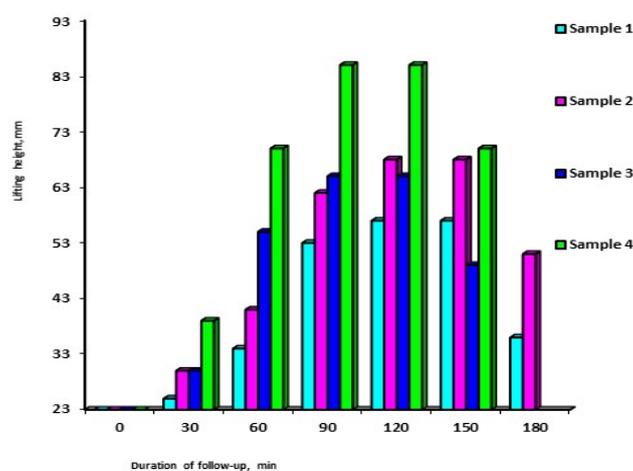
Name of the indicator	Cow milk whey	Goat milk whey
Appearance and texture	Homogeneous liquid	Presence of protein precipitate
Color	Pale green	White-greenish
Taste and smell	Is characteristic of whey, sour	Specific to whey, sour, strong

It can be seen from the table that organoleptic indices of whey from cow and goat milk slightly differ in color and smell.

A comparative analysis of 4 samples of semiproducts for lifting force was carried out. The data obtained are shown in Figure 1. The experiment variants are presented in Table 3.

**Table 3. Experience Options**

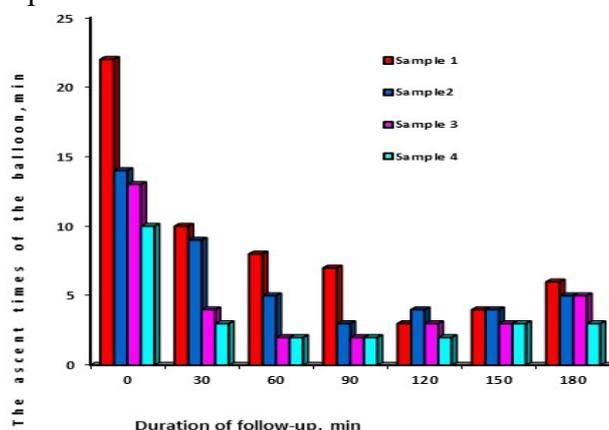
Sample	Option Experiences
1	Control with whey from cow's milk
2	Control with goat's milk whey
3	Wheat-amaranth mixture (85:15) with whey from cow's milk
4	Wheat-amaranth mixture (85:15) with goat's milk whey



**Figure 1. Lifting power of semiproducts**

The graphics shows that the goat whey increases the lifting force, with the addition of amaranth flour 15 %. Lifting force is increased by 1.5 - 2 times.

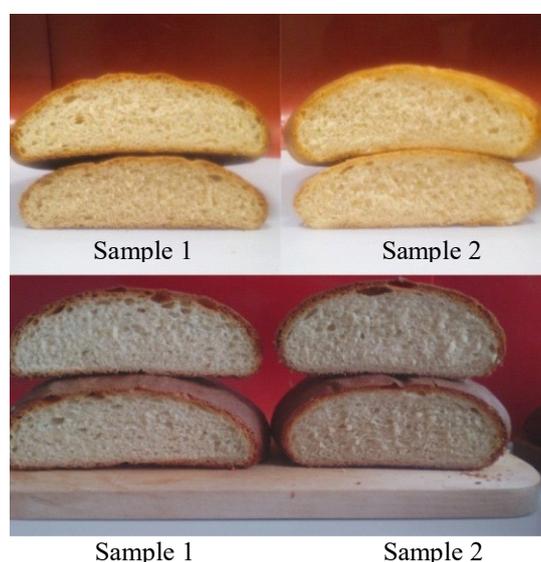
When studying the influence of various milk whey on the technological process of bread preparation, we examined the fermentation process (Figure 2). We have established that it is possible to regulate the yeast fermentation activity at the stages of fermentation of the dough and proofing, based on the rational use of secondary raw materials of livestock products.



**Figure 2. Fermentation activity of semi product**

It can be seen from the diagram that the addition of amaranth flour and goat's whey reduces the ascent time of the ball, which is the sign of increased yeast fermentation activity and acid accumulation. As a result, the fermentation time is shortened by 60 min, the proofing time is 5-10 min. Wheat - amaranth and wheat bakery products with whey and goat milk whey were prepared according to OST 18. 251-75 in a free-form way. The duration of the fermentation process was 60 minutes with a single dough test. Amaranth flour was added in an amount of 15 % of the total mass of wheat flour. All raw materials: wheat flour of superior quality, yeast pressed bakery, salt, margarine were made according to the recipe. Water was added by calculation, white sugar was added in an amount of 3.5 % of the total mass of the flour.

The buns were shaped and left for 40 minutes, baked at 192 °C for 40 minutes. The baked products were cooled in air at room temperature (Figure 3). After the cooling of bakery products, their quality was assessed for organoleptic and physicochemical parameters (Tables 4 and 5).



**Figure 3.** Finished bakery products in section

**Table 4.** Organoleptic indicators of the quality of bakery products

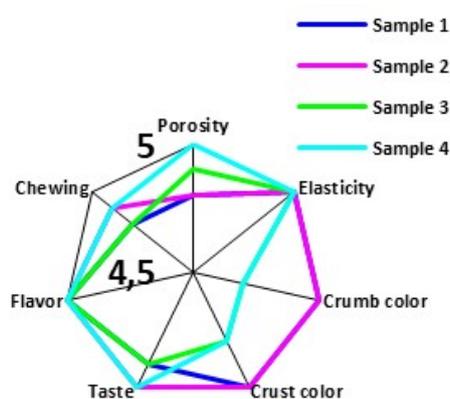
Name of indicator	Characteristics			
	Sample 1	Sample 2	Sample 3	Sample 4
Appearance: form	Oval, without press			
Surface	Without large punctures. Smooth, without cracks. There is no peel of bread crumb			
Color of light	Brown	Brown	Brown	Dark brown
Crumb condition:	Baked, not sticky, elastic. After a slight pressure on the fingers, the crumb assumes the original shape			
Promes	Without lumps and traces of impurities			
Porosity	Developed, without emptiness and seals	Uneven	Developed	Developed, without emptiness and seals
Taste	Characteristic of this type of product, without foreign taste			
Smell	Characteristic of this type of product, without foreign smell			

According to the data obtained in Table 5, it was found that all 4 samples have high taste and nutritional properties, have a good taste, smell and appearance, and retain their freshness for a long time.

**Table 5.** Physicochemical indicators of the quality of bakery products

Indicator name	Sample 1	Sample 2	Sample 3	Sample 4
Moisture of the crumb, [%]	39.4	40.2	37.2	39.2
Acidity of the crumb, [degree]	9	10	10	12
Porosity of crumb, [%]	60	64	69	72

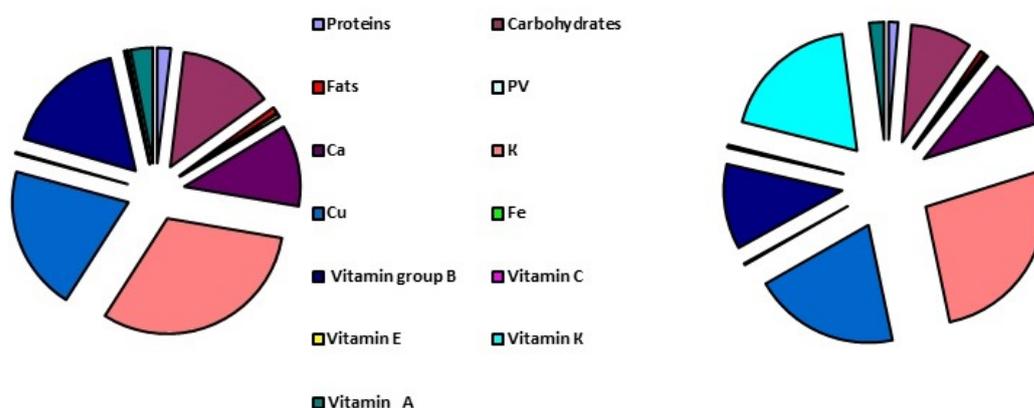
It was found that the most significant effect on the quality of wheat bread is the application of 15 % dosage of amaranth flour and whey from goat's milk. The porosity of the crumb of wheat-amaranth products with whey from goat's milk increases by 16 - 20 %. A tasting inspection of quality of bakery products was conducted. The results are shown in Figure 4.



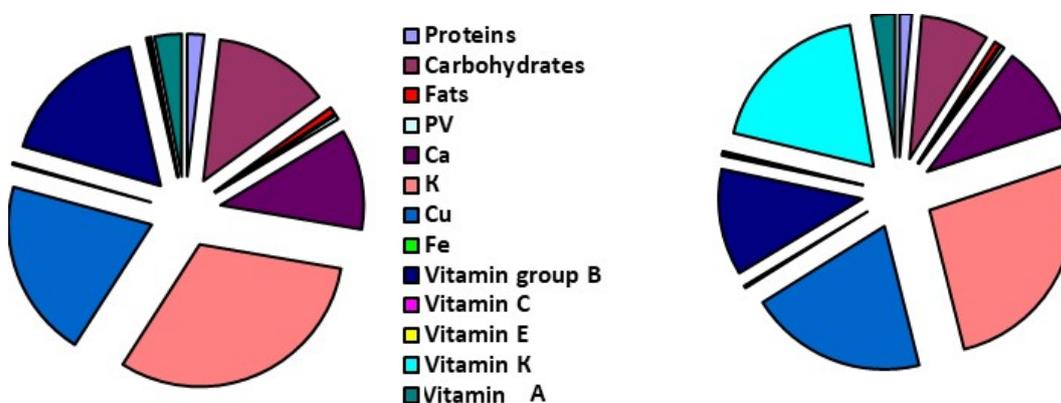
**Figure 4.** Score evaluation of bakery products

Based on the tasting quality inspection of bakery products using a 5-point scale, it was concluded that all samples have intensely expressed aroma and elasticity characteristic for this kind of products. In sample 1, the color of the crumb and crust is characteristic. In sample 2, the color of the crust, the color of the crumb, taste and chewiness are intensely expressed. Sample 4 has pleasant taste, developed porosity and is well chewed.

We have determined the influence of amaranth seed processing products and various milk whey on the nutritional value of bakery products (Figures 5 and 6).



*Figures 5. Nutritional value of baked goods with whey from cow's milk*



*Figures 6. Nutritional value of baked goods with goat's milk whey*

A comparative assessment of the chemical composition of baked goods with whey from cow's milk and amaranth flour showed that in the produced bakery products the protein content increased almost 1.5 times in comparison with the control samples. The total content of micronutrients increased several times: vitamins averaged 1.5 times; mineral substances - 2 times.

A comparative assessment of the chemical composition of baked goods with whey from goat's milk and amaranth flour showed that in the developed bakery products the protein content increased almost 2 times in comparison with the control samples. The total content of micronutrients increased several times: vitamins averaged 2 times; mineral substances - 3 times.

When adding amaranth flour, the bakery product is enriched with vitamin K.

Thus, the produced products are characterized by increased nutritional value and can be recommended for mass consumption with the aim of enriching the food ration with vegetable protein, vitamins and micronutrients.

## CONCLUSIONS

On the basis of the made researches the following conclusions are made:

1. It has been revealed that in the whey of goat milk there is a protein precipitate and a sharp sour smell.
2. The goat whey increases the lifting power with the addition of amaranth flour 15 %. Lifting force is increased by 1.5 - 2 times.
3. It is established that all 4 samples have high taste and nutritional properties, they have excellent taste, smell and appearance, they retain their freshness for a long time.
4. It was revealed that a significant influence on the quality of wheat bread is made by applying 15 % dosage of amaranth flour and whey from goat's milk. The porosity of the crumb of wheat-amaranth products with whey from goat's milk increases by 16-20 %.
5. It is found out that all samples have intensely expressed aroma and elasticity characteristic for this kind of products. In sample 1, the color of the crumb and crust is characteristic. In sample 2, the color of the crust, the color of the crumb, taste and chewiness are intensely expressed. Sample 4 has pleasant taste, developed porosity and is well chewed.
6. The produced products are characterized by increased nutritional value and can be recommended for mass consumption in order to enrich the food ration with vegetable protein, vitamins and micronutrients.

## REFERENCES

1. Ashilkhanov, A.S., Smolnikova, F.Kh.: Application of dairy whey in bakery, *Collected materials of the International Scientific and Technical Conference (correspondence), Innovative technologies in the food industry: science, education and production*, **2013**, 69-72;
2. Grishina, E.S., Gavrilova, N.B., Konovalov, S.A.: Production of bakery goods using dairy products (review of literature), *Bulletin of the Omsk State Agrarian University*, **2014**, 4 (16), 45-48;
3. Berry, D.: Prospects for the use of dairy ingredients, *Confectionery and bakery*, **2010**, 2, 6-7;
4. Grishina, E.S., Gavrilova, N.B., Konovalov, S.A.: Improving the biotechnology of bakery products, *Bulletin of the Altai Science*, **2015**, 1, 359-363;
5. Shishkina, A.N., Sadigova, M.K., Belova, M.V., Larin, Yu.N., Astashov, A.N.: Biotechnological properties of a wheaten semi-finished product with addition of amarantovy flour, *XXI century: results of the past and problem of the present plus*, **2018**, 3 (43), 49-53;
6. Zueva, E.A., Sluginova, N.I., Sarafankina, E.A.: On the prospects of using whole-hulled amaranth flour in the production of wheat bread, *XXI century: the results of the past and the problems of the present plus*, **2017**, 01 (35), 37-40;
7. Sala, M., Berardi, S., Bondioli, P.: Amaranth seed: Le potenzialità, *Rivista. Italiana Sostanze Grasse*, **1998**, 11, 503-506;
8. Grosu, L., Fernandez, B., Grigoraş, C.G., Patriciu, O.I., Grig-Alexa, I.C., Nicuță, D., Ciobanu, D., Gavrilă, L., Finaru, A.L.: Valorization of whey from dairy industry for agricultural use as fertiliser: effects on plant germination and growth, *Environmental Engineering and Management Journal*, **2012**, 11 (12), 2203-2210;
9. Sinkevich, T., Riedel, K.L.: Milk whey: processing and use in the agro-industrial complex, *Edited and preface by H.H. Lipatov, M: Agropromizdat*, **1989**, 270;
10. Khramtsov, A.G.: The phenomenon of whey, *Second Profession Brewing*, **2011**, 804;
11. Grosu, L., Alexa, I.C., Patriciu, O.I.: Study concerning the production of biomass protein by valorisation of by-products from the dairy industry - (etude concernant l'obtention de biomasse proteique par valorisation des sous-produits de l'industrie laitiere), *Scientific Study & Research - Chemistry & Chemical Engineering, Biotechnology, Food Chemistry*, **2015**, 16 (2), 169-172;

12. Tertychnaya, T.N., Manzhesov, V.I., Mazhulina, I.V., Kalashnikova, S.V.: Modern technologies of bakery production: textbook, *Voronezh: FGBOU Voronezh State University of Automated Control*, **2018**, 189;
13. Paschenko, L.P., Zharkova, I.M.: Technology of bakery production, *SPB Publishing House "Lan"*, **2014**, 672;
14. Tertychnaya, T.N., Mazhulina, I.V., Kalashnikova, S.V.: Technology of processing of crop production, *Textbook, SPb, GIOR*, **2016**, 807;
15. Tertychnaya, T.N., Manzhesov, V.I., Andrianov, E.A., Krivtsova, S.N.: Development of the cake recipes for functional purposes with dog rose and broccoli, *Bread products*, **2017**, **2**, 40-41;
16. Bulekov, T.A., Gumarova, A.K., Chinarova, E.R.: Technological parameters of flour mixtures from non-traditional raw materials, *Science News of Kazakhstan*, **2013**, **3** (117), 48-53;
17. Ponomareva, E.I., Lukina, S.I., Sadygova, M.K.: Development of cake for specialized food and assessment of its quality, *Vestnik of the State University of Civil Aviation*, **2016**, **6**, 84-88;
18. Kanareikina, S.G., Akhatova, I.A.: New approaches to the processing of dairy raw materials for the production of products of children's and dietary nutrition, *Ufa: Gilem, Baksh Encyclopedia*, **2014**, 136;
19. Açu, M., Kinik, Ö., Yerlikaya, O.: Functional properties of the probiotic ice cream prepared from goat's milk, *Carpathian Journal Of Food Science And Technology*, **2017**, **9** (4), 86-100;
20. Manjula, K., Bhagath, Y.B.: New generation functional foods-A prospectus on processing technology assistance in development and production-A Review, *Carpathian Journal Of Food Science And Technology*, **2017**, **9** (2), 64-76.