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The Use of Topinambur (*Jerusalem artichoke*) Concentrate in the Curd Production

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ABSTRACT

Curd production technology upon the use of topinambur (Jerusalem artichoke) tuber has been developed. For the curd production, hydrolyzed concentrate obtained from the tuber of Jerusalem artichoke has been used in the form of herbal supplement. New food product exceeds the traditional one in its biological values due to enrichment with carbohydrates, vitamins, nonessential and essential amino acids. The optimal dose of introducing the hydrolyzed concentrate has been also determined.

The use of hydrolyzed concentrate of Jerusalem artichoke solution reduces the coagulation duration of milk mixture and increases the product yield; at the same time it saturates the product with inulin.

Introduction

Each civilized country seeks to ensure welfare of its population by making the food production sector viable and prosperous branch of economy with clear understanding that food product is the foremost need for humanity. The nation's health and mental capacity also depends on the quantity and quality of the food product consumed by the population. One of the most important prerequisites of a healthy nation is the use of high-quality and vitamin rich food, which very often stays behind the scope of the society being engaged in multiple social problems. For most people the food safety and wholesomeness is not so much important as its price availability. Taking into account the aforementioned issues the use of protein food becomes rather relevant.

Curds, curd mass, curd cheese and albumin curd belong to the range of high-protein dairy products. Curd is a rather useful milk concentrate with high content of calcium salts. Curd products are easily and almost completely digested by the human body. They are rich in essential amino acids (methionine), vitamins (particularly *A*, *E*, *P*, *B*₂, *B*₆ and *B*₁₂), folic acid, calcium salt, iron, sodium, magnesium, copper, zinc, fluorine and phosphorus. Just due to the mentioned compounds curd is digested rather easily. As a food product variety curd is necessary for the growth and regeneration of all body tissues. It is useful for nervous system, heart activity and blood system. It should be added that the high content of calcium makes curd product indispensable in case of tuberculoses, bone

fractures, diseases of hematopoietic system and rickets.

The main objective of the current work is to produce a curd product rich in vitamins, amino acids, protein and micro-macro-nutrients. To this end the following activities should be accomplished:

- to study the effect of topinambur on the biotechnological procedures,
- to study the role and impact of herbal supplement on the produced foodstuff,
- to test the optimal dose ratio of the topinambur concentrate used for the curd production
- to study the biochemical, physicochemical and microbiological processes taking place throughout the curd production process.

The use of specially processed topinambur in curd production process has been investigated for the first time. Due to this crop the product acquires easily digestible carbohydrates, vitamins (*B₁*, *B₃*, *B₅*, *B₆*), folic acid, calcium and minerals (*K*, *Ca*, *Mg*, *Na*, *Fe*). Topinambur contains inulin, which has an absolute sorbent capacity; it binds and expels a huge amount of toxins penetrated into the body intestine via food intake or during digestion. Besides, inulin stimulates the motility of gastrointestinal tract. Addition of topinambur concentrate affects the water absorption capacity and the protein content in the curd products.

Materials and methods

Curd belongs to the range of high-protein dairy products and is produced via milk coagulation with pure lactic acid cultures. Topinambur is endowed with soothing, immune-boosting, body-strengthening, anti-sclerotic, toxin-removing, cell-membrane protecting (in case of excessive glucose, water amount grows up and damages the cells) effects. According to some data, topinambur (mannose) can prevent the occurrence and development of autoimmune diseases and cancers. The energy value of 100 g topinambur tuber amounts to 73 kcal. The same mass contains 78 g water, 2.54 g ash, 2 g protein, slight amount of fats - 0.01 g unsaturated fatty acids, 0.067 g omega-3, 0.256 g omega-6 and saturated fatty acids 0.145g (<https://www.dasaran.am>).

Inulin is a compound sugar consisting of residual fructose molecules. It is not dissolved in cold water, while due to the inulosucrase enzyme it gets dissolved in the lukewarm acidic gastric juice, then swells up and expands into the colon without splitting. Thereafter it covers the intestinal mucosa, due to which the transfer of glucose and cholesterol

into the blood is retarded. Up to 14 g and more inulin can be found in 100 g topinambur tuber. Plant sterols (9 mg, 16.4 %) also have anti-cholesterol effect. Inulin absorbs harmful and toxic matters, including glucose and fructose. In recent years it has been disclosed that inulin really reduces the burden of insulin producing organ, but it can't substitute insulin. It is important to know that topinambur contains chrome (3.5-18 mkg, 24 %) which increases tissue susceptibility towards the insulin, and vanadium (24 %) imitating the insulin effect. The general chemical composition of topinambur tubers (Table 1, 2) depends on the crop variety and harvest time.

Table 1. The general chemical composition of topinambur tubers*

Chemical composition	Quantity, %
Dry matters	20.2-25
Inulin	2.5-20
Membrane	0.6-1.25
Nitrogen containing matters	1.4-2
Proteins	up to 2
Ash	0.9-1.2

Table 2. Amino-acid composition of topinambur tubers*

Amino acids	Tubers	Green mass
Protein	8.33	0.50
Lysin	0.33	0.46
Histidine	0.21	1.10
Arginine	0.45	1.02
Threonine	0.29	0.53
Tyrosine	0.12	0.13
Valine	1.33	1.06
Phenylalanine	0.48	0.38
Leucine	0.89	2.11
Tryptophan	0.83	2.12

*Composed by the authors.



Figure 1. Technology of water-soluble extract production (composed by the authors).

Based on the use of the crop varieties and their samples a highly profitable, loss-free, resource-saving agri-food production technology encompassing all production phases for complex processing of topinambur tubers, has been developed (Polyanskiy, et al., 1999).

The technology of producing water-soluble extract out of the inulin-containing topinambur tubers is introduced in Figure 1.

Results and discussions

The experimental samples of the curd mass have been produced in the laboratory of the chair of “Animal-Based Foodstuff Processing Technology”, ANAU. The experimental and control samples of the curd mass have been produced from the same batch of normalized milk through common technology. After determining the physicochemical indices of the used raw material (milk), the pasteurized milk is cooled to the coagulation temperature - 30-32 °C. Then 40 % $CaCl_2$ solution (40 g) per 100 kg milk and 2-3 % coagulant (ferment) is added to the heated milk (Dilanyan, 1962).

All ingredients have been added by stirring up the milk uninterruptedly. 1.5 % - 2.0 % topinambur concentrate and 3% - 5 % hydrolyzed topinambur juice is mixed in the experimented sample. The end of milk coagulation and the final coagulum is determined through its pH value, which should be equal to 5.1-5.2 (or according to the serum titratable acidity 75-85 °T) and by the serum form isolated from the coagulum. If during the coagulum cutting, equal cutting edges are formed with glossy smooth surfaces, it means that the coagulum is ready for further processing. The serum emerged in the cutting place should be transparent and of light greenish color (Beglaryan, R., Beglaryan, A., 2003, Zobkova, 2019).

The quantities of topinambur concentrate and hydrolyzed juice are introduced in Table 3, based on which the optimal dose with the account of organoleptic indicators (Table 5) has been identified.

Table 3. The optimal quantity of topinambur concentrate and hydrolyzed juice*

Sample	The quantity of topinambur concentrate, %	The quantity of hydrolyzed juice, %	Duration of coagulation, h
Control	0	0	8
Experimental 1	2.0	7.0	6.5
Experimental 2	1.5	5.0	6
Experimental 3	1.0	3	7

*Composed by the authors.

Table 4. The technological indicators of the curd produced through the developed technology (Gharagulayan, 1980)

Technological indicators	Experimental	Control
Fat content of the concentrate, %	3.9	3.9
Titratable acidity, °T	19	19
Pasteurization temperature, °C	74	74
Holding minutes	2-3	2-3
Coagulation temperature, °C	30-32	30-32
The dose of added coagulant, %	3	3
The dose of added calcium chloride, g	40 g per 1 ton of milk	40 g per 1 ton of milk
The dose of topinambur concentrate, %	1.5	0
The dose of hydrolyzed topinambur juice, %	5	0
Coagulation duration, hour	6	8
Acidity at the end of coagulation, °T	80	88
Coagulum PH	5.1	5.2
Coagulum cutting and granulation, minute	25	30
Granule size, mm	18-20	18-20
Fat content of whey, %	0.2	0.3

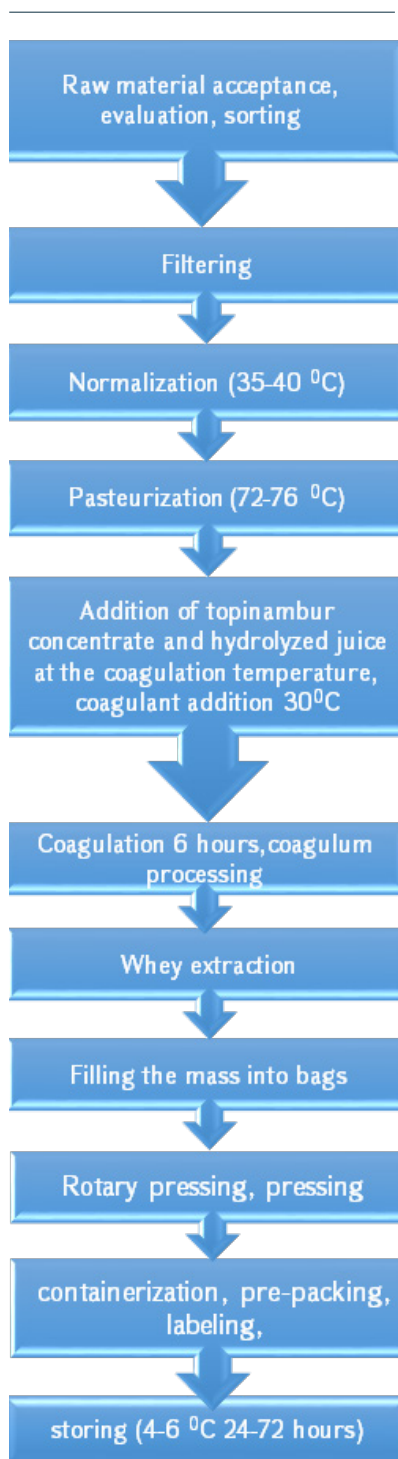


Figure 2. Diagram for the technological scheme of curd production (composed by the authors).

Table 5. The effect of topinambur quantity on the organoleptic indicators of curd product*

Indicators	The options of experiments			
	Experimental 1	Experimental 2	Experimental 3	Control
The added quantity of topinambur concentrate, %	2.0	1.5	1.0	-
The added quantity of hydrolyzed topinambur juice, %	7.0	5.0	3.0	-
Fat mass ratio, %	18	18	18	18
Water mass ratio, %	65	71.5	72.5	73.5
Titrate acidity, °T	197.5	195	193.5	192
Taste and flavor	Lactic acid, well distinguished topinambur taste and flavor	Lactic acid, without off-taste and off-flavor, slightly distinguished topinambur taste and flavor	Lactic acid, without off-taste and off-flavor, undistinguished topinambur taste and flavor	Lactic acid, without off-taste and off-flavor
Color	White with distinguished topinambur tinge	White with slightly distinguished topinambur tinge	White	White
Appearance	Dense homogeneous whole mass	Fine, slightly dense, homogeneous whole mass	Homogeneous whole mass	Fine, homogeneous whole mass

*Composed by the authors.

The new technological scheme of curd production is introduced in Figure 2, while the technological indicators of the produced curd are presented in Table 4.

Due to the topinambur concentrate the curd product content is supplemented with easily digested carbohydrates, vitamins and minerals. The mentioned products can serve as a

prophylactic and treating measures for the patients suffering from the diseases of gastrointestinal tract and diabetes. The extract which is subjected to hydrolysis is also very useful for diabetics.

Considering the aforementioned we can state that the use of plant concentrates enables to diversify food product varieties, improve the food quality and use it in the therapeutic and prophylactic diet.

The processing of topinambur tubers was conducted in the following way: after processing of 1 kg topinambur tuber its net mass made 988 g. After grinding the tubers, its pulp weight made 850 g and the extract – 570 g. The pulp was dried up at the temperature of 50 °C and 305 g concentrate was resulted. The amount of dry matters dissolved in the extract of topinambur tubers was examined by means of KERN ORA 32BA refractometer, according to which they made 22 %. Then 570 g extract was filtered with filter paper and it became 550 g. The filtered solution was hydrolyzed with 2 g citric acid salt (boiling for 20 minutes) resulting in 382 g hydrolyzed solution. The hydrolyzed solution was diluted with distilled water 3 times, as a result of which the amount of dry matters made 63 %. Relatively higher organoleptic indices were recorded in the curd mass with 1.5 % concentrate and 5 % hydrolyzed solution. The study results have indicated that the application of optimal dose of topinambur tubers increases the curd mass yield by 1.1 %. As a result, the curd mass obtains specific taste, flavor and homogeneous fine density.

The application of plant additives doesn't affect the microbiological indicators and promotes the production of food variety with new delicate flavor properties, high nutritional and biological value and with relatively longer shelf life.

Conclusion

Based on the results of scientific-research and theoretical-experimental investigations the following conclusions have been inferred:

The feasibility of using topinambur tubers in the curd

production has been theoretically justified and empirically confirmed. It has been proved that the biological value of the curd product manufactured with the experimented topinambur tubers is more complete, than that of observed in traditional food product. This is related to the availability of topinambur tubers rich in carbohydrates, essential amino acids and vitamins, which make the food product easily digestible. It is recommended to use topinambur tubers' concentrate (upon drying method) and hydrolyzed juice, which contains a great amount of carbohydrates, (mainly inulin) as herbal supplements in dairy industry. In the initial stage it is transformed into fructose, glucose and other carbohydrate containing mediums via acidic hydrolyzation.

Thus it is also recommended to use the optimal dose of topinambur tubers' concentrate and hydrolyzed solution, which results in the reduction of curd mass coagulation period and in the increase of the product yield.

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