УДК 664.68:637.142.2

Sabirov O.V., Cand. Sc. (Tech.),
Malyakova G.I.

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky, Donetsk, Ukraine, e-mail: junnesc@yandex.ru

DESIGN OF THE PRODUCTION PROCESS OF MILK WHEY SEMI-FINISHED UNFERMENTED FLAKY DOUGH

Сабіров О.В., канд. техн. наук,
Малякова Г.І.

Донецький національний університет економіки і торгівлі імені Михайла Туган-Барановського, м. Донецьк, Україна,
e-mail: junnesc@yandex.ru

РОЗРОБКА ТЕХНОЛОГІЇ ВИРОБНИЦТВА ПРІСНОГО ЛИСТКОВОГО НАПІВФАБРИКАТУ НА ОСНОВІ МОЛОЧНОЇ СИРОВАТКИ

Objective. *The article is purposed to study the impact of milk whey on qualitative characteristics of semi-finished unfermented flaky dough and to design production technology on its basis.*

Methods. *Standard methods for determining product yield and moisture content in produced semi-finished unfermented flaky dough were used during the study. Also, new methods on determining elasticity, resilience and stretching of the dough for semi-finished products were proposed.*

Results. *We offer to replace water and citric acid in production of semi-finished unfermented flaky dough by milk whey. Milk whey is a valuable source of essential aminoacids. In addition, milk whey is characterized by a low-level of industrial processing. On the basis of the carried out study, positive impact of citric acid on qualitative characteristics of semi-finished unfermented flaky dough was proved. Elasticity and stretching of the studied sample are similar to the semi-finished sample made according to the standard technology. Resilience of the studied semi-finished dough is even better than the standard product. Product yield and moisture content of the produced semi-finished dough correspond to the requirements of the documentation on standardization. The study offers to produce semi-finished unfermented flaky dough with replacement of water and citric acid by milk whey.*

Scientific novelty. *This study is the first proposing replacement of water and citric acid use in semi-finished unfermented flaky dough production by milk whey which is a valuable source of essential aminoacids. Also, methods of determining elasticity, resilience and stretching, as well as methods of analysis of semi-finished unfermented flaky dough under these parameters, were improved.*

Practical value. *The technology of semi-finished unfermented flaky dough production on the basis of low-level industrial processing milk whey was designed according to the received results.*

Key words*: semi-finished unfermented flaky dough, milk whey, elasticity, resilience, stretching, product yield, moisture content.*

Problem definition. Confectionery is products with good accessibility, nice smell and taste. The most popular among them (nearly 42%) are confectionery made of flour [1]. Traditionally, the most popular confectionery among Ukrainians is products made of unfermented flaky dough [2].

Andreiev, A.V., Smelik, V.A., Belyaieva, L.M., Pankovsky, G.A., and Poliakova, A.V. constitute a small list of researchers who were inclined in the improvement of flaky dough production technology. But mostly their work was aimed on replacement fats for making more puffs in flaky dough or adding some antioxidants to prolong shelf life of semi-finished products and confectionery made of it.

Products made of flaky dough are characterised by high fats content necessary for their flaky structure and tenderness, which are the results of numerous puffs of the dough [3].

But the products of this group are also characterised by low level of proteins which negatively influences their nutrition value.

Analysis of the latest researches and publications. One of the most perspective ways of creating a great variety of products and making the nutrition value higher of the flour-based confectionery is design of new production technologies with use of secondary diary raw material which is a source of proteins. The most attractive product among secondary protein-carbohydrate diary raw material (these materials are obtained after production of cheese, acid curd cheese, and casein) is milk whey. Biological value of milk whey is determined by proteic nitrogenous compounds (e.g. essential aminoacids), carbohydrates, lipids, mineral salts, vitamins, organic (carboxylic) acids, etc. [4].

Standard technology prescribes using of citric or tartaric acids as improving agent of gluten quality at dough kneading. It is well-known that protein viscosity gets higher in weak acid medium. As the result, dough becomes more elastic and resilient [5]. Milk whey, containing organic (carboxylic) acids, may be used as a replacing agent.

The timeliness of this technology is in replacing water and citric acid in production of semi-finished unfermented flaky dough by milk whey. Milk whey is a valuable source of essential aminoacids. In addition, milk whey is characterized by a low-level of industrial processing.

Making purposes of the article. The purpose of the article is design of semi-finished milk whey-based unfermented flaky dough production technology. To reach the above-mentioned purpose, we set the task to research the impact of acid whey on the qualitative characteristics of semi-finished unfermented flaky dough, especially its elasticity, resilience, and stretching of dough, moisture content and product yield.

Primary study material We carried out the impact of whey on the qualitative characteristics of semi-finished flaky dough and products made of it. As a studied sample, we cooked dough where citric acid and water were replaced by whey. The reference samples were represented by flaky dough cooked under standard technology and unfermented dough without content of gluten quality improving agent – organic (carboxylic) acids. The quantity of whey was calculated basing on the moisture content of dough (40%), and taking into account moisture of original raw material. Recipe setting see in Table 1.

Table 1 – Recipe setting of samples

Raw materials	Consumption per 100 grams of the dough		
	Studied sample	Reference sample cooked with citric acids	Reference sample cooked without citric acids
Flour	56,72	57,90	57,92
Butter	3,98	4,06	4,06
Melange	2,87	2,94	2,94
Salt	0,45	0,46	0,46
Citric acid		0,08	
Water		34,57	34,62
Milk whey	35,97		

All the researches were carried out 5 times.

To define the type of whey impact on the qualitative characteristics of gluten, we proposed a method of determining elasticity and resilience of dough. For this method, it is necessary to have a dough sample batch weight of 5 g. Then, it should be put on a sheet glass oiled by a seed-oil and located on a millimetre squared paper. It is required to record the size of the dough sample. The sample should be covered by the same sheet glass as the one it is placed

on. Then, a 1 kg weight should be put on it for ten minutes. After this, take 1 kg weight and cover glass sheet off the lower glass sheet with batch weight. Then, diameter of the dough sample should be marked on the millimetre squared paper in several dimensions. Elasticity unit is change of sample area after applying the weight. It is denoted in %.

Then, the sample is remained without weight for ten minutes. After this, reduction in diameter is marked. Resilience unit is change of sample area relatively to the area after applying the weight. It is denoted in %.

The results of the research are presented at the Figures 1 and 2.

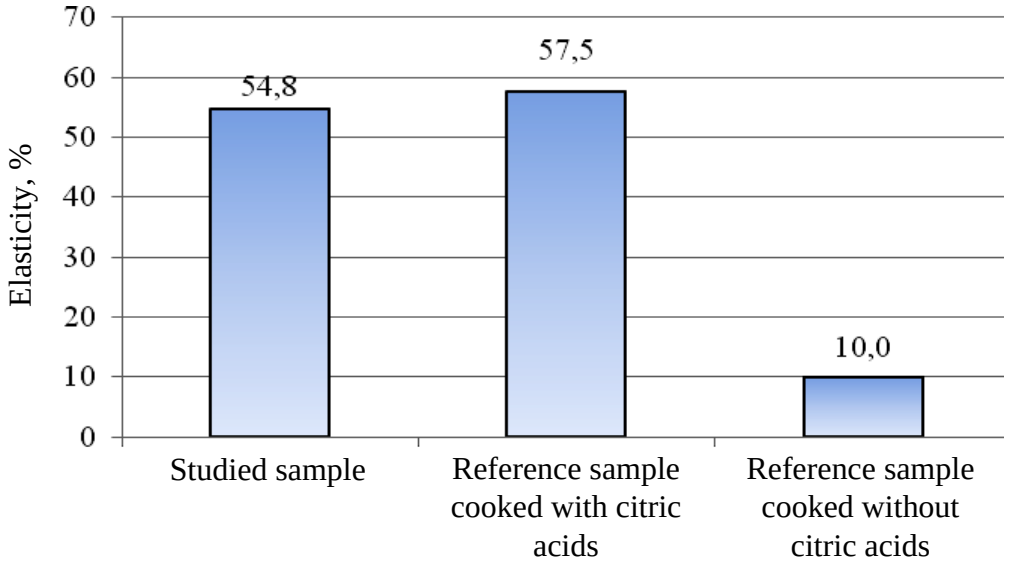


Figure 1 – The results of the research of dough elasticity

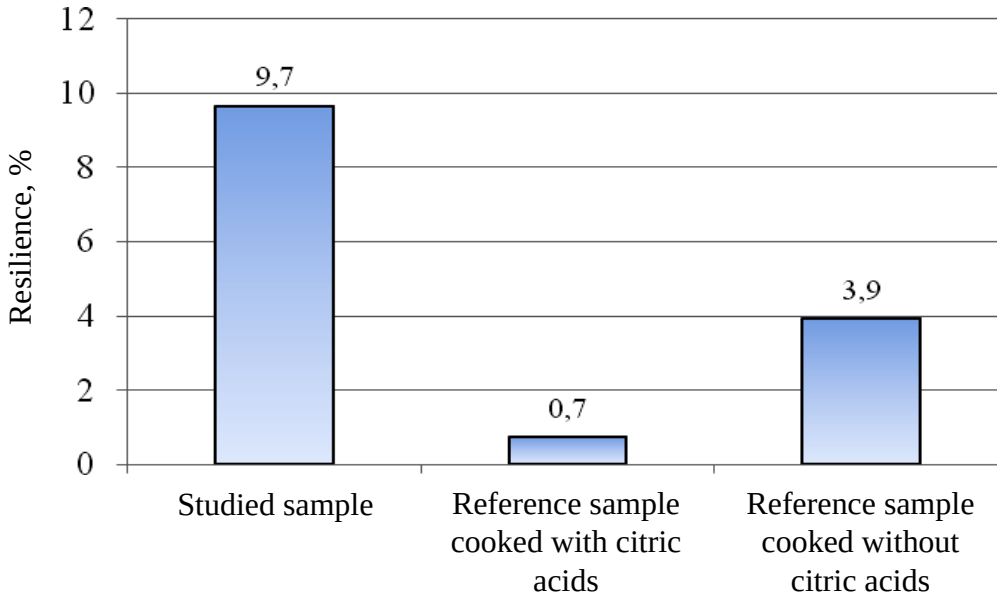


Figure 2 – The results of the research of dough resilience

According to expectations, the reference sample without acids is characterised by low elasticity. Its area enlarged by 10,0% after taking the weight off, which is 5,8 times lower than has the sample cooked with citric acid. As we can see from the figures, elasticity of dough

with whey is only 4,8% lower than elasticity of the reference sample cooked with citric acid. It constituted 54,8% which is in the range of experimental uncertainty.

But the reference sample without acids has higher resilience in comparison of citric acid – it is 5,6 times higher (3,9%). The studied sample has resilience of 9,7%, which is higher for 148,7% than resilience of sample cooked without acids.

Thus, the studied sample has higher parameters of elasticity and resilience than reference samples. This positively influences the quality of semi-finished dough and products made of it.

Researches of dough stretching were carried to prove that elasticity of gluten grew higher. Batch weight of 10 g was stretched with equal force above a ruler. It was required to fix the length at which the sample broke. Stretching is presented as difference of sample length prior to stretching and length at breaking. It is shown in %.

The results of the research are presented on the Figure 3.

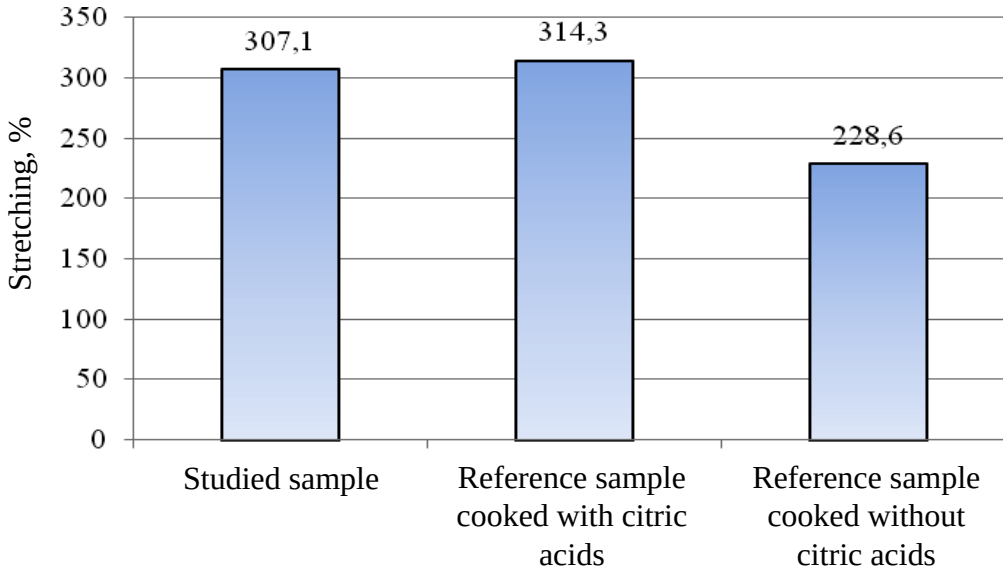


Figure 3 – The results of the research of dough stretching

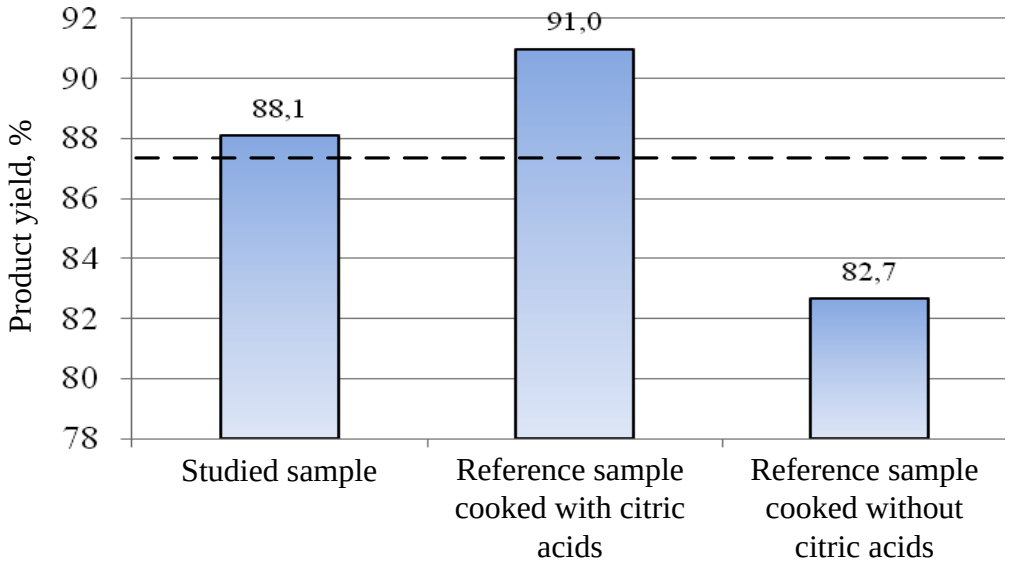
As we can see on the figure, the reference sample cooked without acids stretches up to 228,6%, which is 27,3% lower than the sample cooked with citric acid. The studied sample stretches up to 307,1% which is only 2,3% lower than the reference sample cooked with citric acid, which is in the range of experimental uncertainty. Results of stretching research of the samples fully correlate with the results of elasticity research.

Product yield is of high importance for manufacturers. Experimental baking of semi-finished dough was made to determine product yield. It should be noted that baked products of the studied sample with milk whey are characterised as brittle, with preserved puff structure, without cores. The colour is golden which corresponds to semi-finished unfermented flaky dough.

The results of the research are presented on the Figure 4.

According to the documentary standards, product yield of semi-finished unfermented flaky dough should not be lower than 86% [5]. As we can see on Figure 4, the reference sample without organic (carboxylic) acids has product yield of 82,7%, which is lower than the standard for 3,8%.

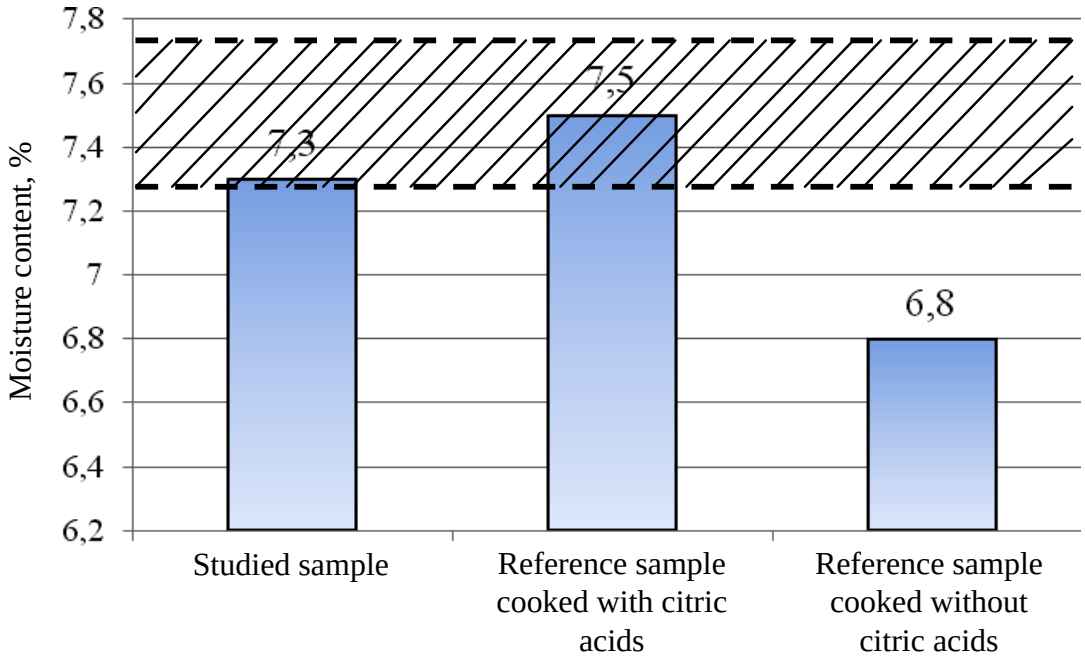
The studied sample and reference sample with citric acid has product yield higher than the standard for 2,0% and 5,8% respectively.



– product yield of semi-finished unfermented flaky dough for normative documents

Figure 4 – The results of the research of product yield

Moisture ontent of the cooked products influences their shelf life. that is why it is required to determine this parameter for the studied samples. The documentary standards set the allowed moisture content of semi-finished unfermented flaky dough at the level of 7,5±3% [5]. Moisture content was determined by means of drying. The results of the research are presented on the Figure 5.



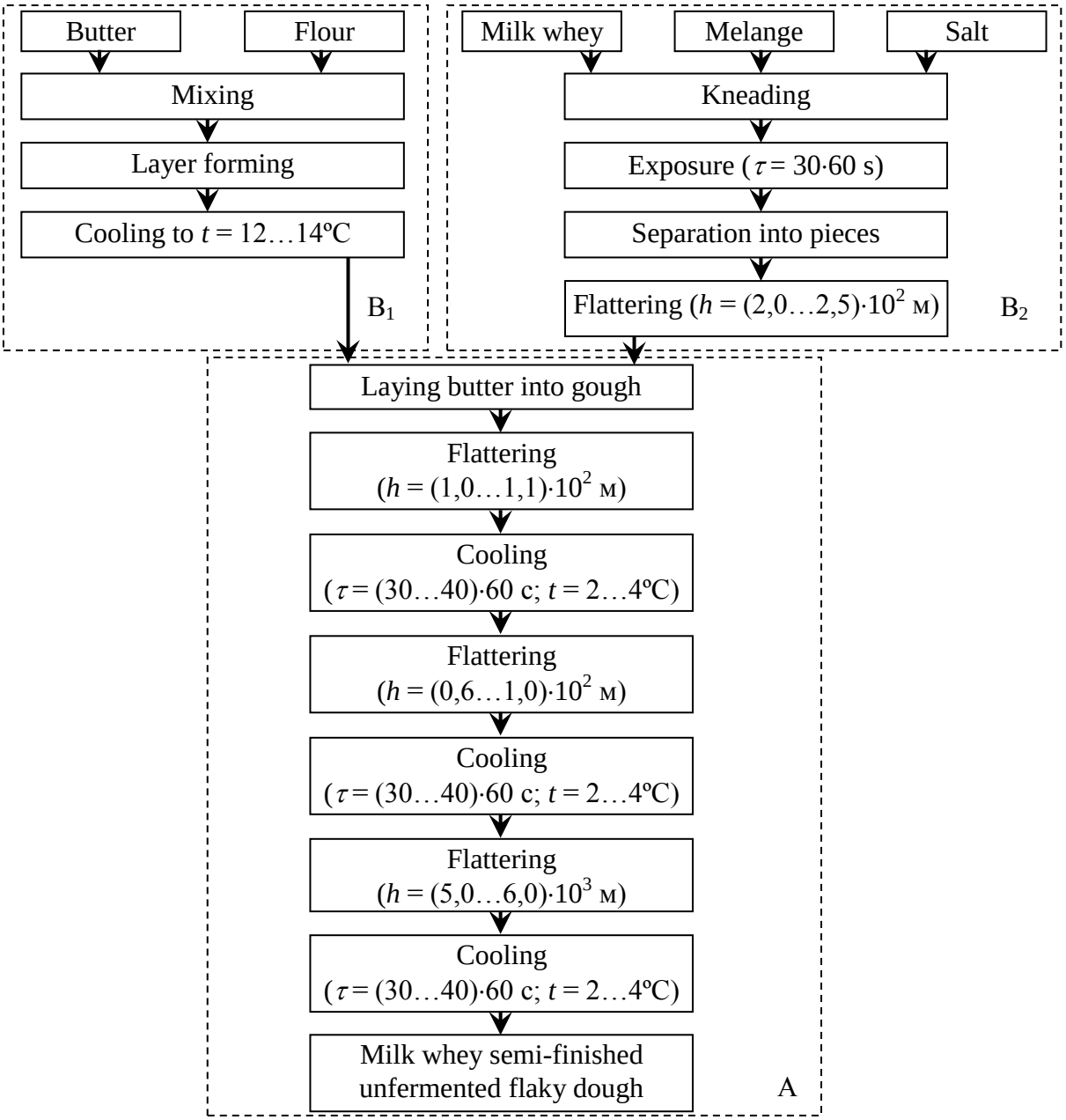
– moisture content of semi-finished unfermented flaky dough for normative documents

Figure 5 – The results of the research of moisture content

Moisture content of studied sample and reference sample with citric acid correspond to the requirements of the documentary standards and comprise 7,3% and 7,5% respectively. Moisture content of the reference sample without organic (carboxylic) acids is 6,8% which is lower than minimum required parameters.

Thus, it is proved that replacing water and citric acid by milk whey positively influences qualitative characteristics of semi-finished unfermented flaky dough and products made of it.

On the received results, we designed a semi-finished milk whey-based unfermented flaky dough production technology. Functional diagram of production is presented on the Figure 6.



A – subsystem of making layers into dough, B_1 – subsystem of butter preparation, B_2 – subsystem of dough kneading

Figure 6 – Schematic technological scheme of milk whey semi-finished unfermented flaky dough

Conclusions. Thus, making out a conclusion of the study, it is possible to say that the positive impact of replacing water and citric acid by milk whey in production technology of semi-finished unfermented flaky dough is proved.

When adding milk whey, resilience of the semi-finished dough is improved.

Also, elasticity, equal to semi-finished dough made under standard technology, and product yield and moisture content of the goods made using such dough, are preserved.

The following study in this direction will cover research of the main chemical parameters of the produced goods, biological value and degree of digestion, as well as their comparison with parameters of the standard goods.

Список літератури / References:

1. Кузнецова Л.С. Технология приготовления мучных кондитерских изделий: учебник для студ. учреждений сред. проф. образования / Л.С. Кузнецова, М.Ю. Сиданова. – 3-е изд., испр. – М.: Академия, 2007. – 320 с.
   Kuznetsova, L.S., Sidanova, M.U. (2007), Tekhnologiya prigotovleniya muchnyih konditerskih izdeliy [Cooking techniques of flour confectionery], Publishing center “Akademy”, Moscow, Russia, 320 p.
2. Полякова А.В. Використання рослинних добавок антиоксидантної дії в технології виробів з листкового тіста: автореф. дис. ... канд. техн. наук : спец. 05.18.16 «Технологія продуктів харчування» / А.В. Полякова. – Донецьк, 2008. – 23 с.
   Poliakova, A.V. (2008), “The usage of antioxidant plant supplements in puff pastry production”, Abstract of Ph.D. dissertation, Engineering, Donetsk, Ukraine, 23 p.
3. Андреев А.Н. Сдобные булочные и мучные кондитерские изделия из слоеного теста / А.Н. Андреев. – М.: ЦНИИТЭИ хлебопродуктов, 1992. – 48 с.
   Andreiev, A. N. (1992), Sdobnyie bulochnyie i muchnyie konditerskie izdeliya iz sloenogo testa [Rich fermented and flour confectionery made of flaky dough], CNIITEI of bakery, Moscow, Russia, 48 p.
4. Храмцов А.Г. Технология продуктов из молочной сыворотки: учебное пособие / А.Г. Храмцов. – М.: ДеЛи, 2004. – 587 с.
   Khramtsov, A. G. (2004), Tehnologiya produktov iz molochnoy syivorotki [Technology of production goods of milk whey], DeLi, Moscow, Russia, 587 p.
5. Мархель П.С. Производство пирожных и тортов / П.С. Мархель, Ю.Л. Гопенштейн, С.В. Смелов. – М.: Пищевая промышленность, 1975. – 320 с.
   Markhel, P.S., Gopshtein U.L., Smelov S.V. (1975), Proizvodstvo pirozhnyih i tortov [Production of pastries and cakes], Food processing industry, Moscow, Russia, 320 p.

Цель. *Цель статьи состоит в исследовании влияния молочной сыворотки на качественные показатели пресного слоеного полуфабриката и разработке технологии с ее использованием.*

Методика. *В процессе исследований использованы стандартные методики определения выхода и влажности готового пресного слоеного полуфабриката и предложены новые методики определения эластичности и упругости, розтяжимости теста для полуфабриката.*

Результаты. *Предложено использовать вместо воды и лимонной кислоты в технологиях изгоготовления пресного слоеного полуфабриката молочную сыворотку, которая является ценным источником незаменимых аминокислот и характеризуется низким уровнем промышленной переработки.*

На основании проведенных исследований доказано положительное влияние лимонной кислоты на качественные показатели пресного слоеного полуфабриката.

По показателям эластичности и розтяжимости теста для полуфабриката опытный образец имеет показатели, близкие к полуфабрикату по традиционной технологии. По пока-

зателю упругости разрабатываемый полуфабрикат имеет лучшие показатели чем традиционный аналог.

Показатели выхода и влажности готового полуфабриката имеют значения, соответствующие требованиям нормативной документации.

Предложенная технология производства пресного слоеного полуфабриката предусматривает полную замену воды и лимонной кислоты на молочную сыворотку.

***Научная новизна.** Впервые предложено использование вместо воды и лимонной кислоты в технологиях производства пресного слоеного полуфабриката молочной сыворотки, которая является ценным источником незаменимых аминокислот; получили дальнейшего развития методики определения эластичности и упругости, розтяжимости теста и исследования пресного слоеного полуфабриката по этим показателям.*

***Практическая значимость.** На основе полученных результатов разработана технология производства пресного слоеного полуфабриката на основе молочной сыворотки, которая характеризуется низким уровнем промышленной переработки.*

***Ключевые слова:** пресный слоеный полуфабрикат, молочная сыворотка, эластичность, упругость, растяжимость, выход, влажность.*

***Мета**. Мета статті полягає у дослідженні впливу молочної сироватки на якісні показники прісного листкового напівфабрикату та в розробці технології його виробництва з використанням*

***Методика.** У процесі досліджень використано стандартні методики визначення виходу та вологості готового прісного листкового напівфабрикату та запропоновано нові методики визначення еластичності та пружності, розтягуваності тіста для напівфабрикату.*

***Результати**. Запропоновано використовувати замість води та лимонної кислоти в технологіях виготовлення прісного листкового напівфабрикату молочну сироватку, які є цінним джерелом незамінних амінокислот та характеризується низьким рівнем промислової переробки.*

На підставі проведених досліджень доведено позитивний вплив лимонної кислоти на якісні показники прісного листкового напівфабрикату.

За показниками еластичності та розтягуваності тіста для напівфабрикату дослідний зразок має показники близькі до напівфабрикату, виготовленого за традиційною технологією. За показником пружності розроблюваний напівфабрикат має кращі показники ніж традиційний аналог.

Показники виходу та вологості готового напівфабрикату мають значення, що відповідають вимогам нормативної документації.

Запропоновано технологію виробництва прісного листкового напівфабрикату, що передбачає повну заміну води та лимонної кислоти на молочну сироватку.

***Наукова новизна.** Вперше запропоновано використання замість води та лимонної кислоти в технологіях виготовлення прісного листкового напівфабрикату молочної сироватки, що є цінним джерелом незамінних амінокислот; знайшли подальший розвиток методики визначення еластичності та пружності, розтягуваності тіста та дослідження прісного листкового напівфабрикату за цими показниками.*

***Практична значущість**. На основі отриманих результатів розроблено технологію виробництва листкового напівфабрикату на основі молочної сироватки, яка характеризується низьким рівнем промислової переробки.*

***Ключові слова**: прісний листковий напівфабрикат, молочна сироватка, еластичність, пружність, розтягуваність, вихід, вологість.*

Рекомендовано до публікації д-ром техн. наук, проф. Кравченко М.Ф. Дата надходження рукопису 10.10.2013 р.