Збереження біорізноманіття тварин

УДК 636.27(477).034:502.211:637.3
DOI: https://doi.org/10.31073/abg.61.25

PECULIARITIES OF CHEESE MANUFACTURED FROM BROWN CARPATHIAN CATTLE MILK

N. L. RIEZNYKOVA[1], I. M. SLYVKA[2]
[1]Institute of Animal Breeding and Genetics nd. a. M.V.Zubets of NAAS (Chubynske, Ukraine)
[2]Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies (Lviv, Ukraine)
https://orcid.org/0000-0002-6030-3463 – N. L. Rieznykova
http://orcid.org/0000-0002-3305-1862 – I. M. Slyvka
reznikovanatasha@ukr.net

Investigation of commercialization possibility of highly endangered Brown Carpathian cattle milk was done at 5 cheese samples. Samples were done on different European high-mountainous cheese-making technologies. Certain physical-and-chemical characteristics of the samples were studied and the organoleptic evaluation was done. It was found, that the milk of Brown Carpathian cattle is valuable from the point of view of its commercialization. M a k i n g of cheese from the milk of Brown Carpathian cattle on different technologies showed the superiority of French Beaufort technology for the milk of the breed on texture, taste and aroma of prepared cheese.
Keywords: **Brown Carpathian cattle, AnGR conservation, commercialization, cheese samples, high-mountainous technologies**

ОСОБЛИВОСТІ СИРУ, ВИГОТОВЛЕНОГО З МОЛОКА БУРОЇ КАРПАТСЬКОЇ ХУДОБИ

Н. Л. Рєзникова[1], І. М. Сливка[2]
[1]Інститут розведення і генетики тварин імені М.В.Зубця НААН (Чубинське, Україна)
[2]Львівський національний університет ветеринарної медицини та біотехнологій імені С. З. Гжицького (Львів, Україна)

Дослідження можливості комерціалізації молока бурої карпатської худоби, яка знаходиться під загрозою зникнення, було проведено на 5 зразках сиру. Зразки були виготовлені за різними технологіями високогірних європейських сирів. Були вивчені певні фізико-хімічні характеристики зразків та проведено їх органолептичну оцінку. Виявлено, що молоко бурої карпатської худоби є цінним з точки зору його комерціалізації. Виготовлення сиру з молока бурої карпатської худоби засвідчило перевагу за текстурою, смаком та ароматом технології виготовлення сиру «французький бофор».
Ключові слова: **бура карпатська худоба, збереження генетичних ресурсів тварин, комерціалізація, зразки сиру, високогірні технології**

ОСОБЕННОСТИ СЫРА, ИЗГОТОВЛЕННОГО ИЗ МОЛОКА БУРОГО КАРПАТСКОГО СКОТА

Н. Л. Резникова[1], И. М. Сливка[2]
[1]Институт разведения и генетики животных имени М.В.Зубца НААН (Чубинское, Украина)
[2]Львовский национальный университет ветеринарной медицины и биотехнологий имени С. З. Гжицкого (Львов, Украина)

Исследование возможности коммерциализации молока бурого карпатского скота, находящегося под угрозой исчезновения, было проведено на 5 образцах сыра. Образцы были изготовлены по различным технологиям высокогорных европейских сыров. Были изучены определенные физико-химические характеристики образцов и проведена их органолептическая оценка. Выявлено, что молоко бурого карпатской скота является ценным с точки зрения его коммерциализации. Изготовление сыра из молока бурой карпатской породы скота показало преимущество по текстуре, вкусу и аромату технологии изготовления сыра «французский бофор».
Ключевые слова: **бурый карпатский скот, сохранение генетических ресурсов животных, коммерциализация, образцы сыра, высокогорные технологии**

Introduction. Biodiversity is the multiple directed issue. It influences human life at different vectors, especially concerning quality of life: qualitative water, qualitative food, qualitative sightseeing, qualitative air and so on greatly depends on "qualitative" biodiversity. Qualitative biodiversity means complex of desirable for human health organisms in interaction. But even when it is not proved, that the biodiversity is useful for human health, it is not evident, that it will not be useful in future or at better investigation. It was even stated, that COVID-19 very likely was caused by attack to and destruction of biodiversity balance [1].

Biodiversity includes plant and animal world. But when we mention biodiversity, mainly people imagine wildlife, but it is not correctly at all, as great part of food safety and security belongs to farm animals and plants biodiversity. Significant amount of farm animal world of Ukraine, country with different animal, plant and landscape diversity in the eastern part of Europe, comprise local autochthonous breeds, which are gradually disappearing because of low volume of their performance, as there are more productive cosmopolitan breeds (Holstein, Swiss). But general trend into direction of monobreed, can lead to the situation, when valuable traits of breeds, which evolved with people of the region during centuries, will be lost forever and irreversible.

It was stated, that global extinction of species in the XXth century was done at a rate, that was "thousand times higher than the average rate during the preceding 65 million years" [24]. Each month six breeds in world scale disappears [19], half of the breeds of domestic animals of Europe have been lost since 1900 on FAO data [27]. Frankly said, it is a lot. So, all our current efforts now should be directed to save our current biodiversity, as Mars's one is far from now (not only in distance, but in time as well). Nearly 100 livestock breeds have gone extinct between 2000 and 2014 [20]. The abundance of assessed populations of vertebrate species fell by nearly one-third on average between 1970 and 2006, and continues to fall globally [21].

Now it is stated, that it is possible to make mass-selection on the base of revealing animals with initially valuable genotype. It became possible, as the influence of each gene or clusters of genes to certain traits is investigated. So, we can reach great desired results, having a lot of genes, not limited number of them, as in case of monobreed. Loosing breed, we lose firstly genes of adaptation to certain environment, disease resistance and a lot of other useful genes-traits. So, again the global task of nowadays is to conserve biodiversity at different levels, including microlevel.

One of the possible ways of biodiversity conservation, including farm animal biodiversity is "conservation through utilization", which means wider use of animals of certain breed or species, promotion of it, their special products and special, useful for people, traits. It can be described at the sample of manufacturer of greatly well-known Parmigiano Reggiano cheese – cows of local Italian breed – Reggiana [19, 23]. Population of this breed numbered 450 cows in 1981, but special taste of the product from this breed milk in favourable con ditions of keeping (Alpine meadows), which were defended by PDO conditions caused wider use of the breed, facilitating its conservation. The success of this direction is proved by other examples, including forthcoming example of Pantaneiro cattle cheese from Brazil [20].

Generally, cheese is very favourable product to reveal the special features of a breed. This product which was known 7000 years ago [14] and in ancient Greece was believed to have divine

origin [11], is a good source of proteins and calcium, phosphorus, A, B2, B12 and other (totally 8 groups) vitamins, aminoacids, which can be re-vealed and compared to show true value of the milk and derivatives [11, 13, 15, 16]. Cheese is assimilated by a human organism up to 100% and has great value. Hard cheeses, moreover, help to save teeth health [11, 12]. It was even stated, that cheese aroma is health ful. It improves appetite and facilitates in secretion of gastric juice [11].

There are hundreds of cheese types in the world and each of them has their own peculiarities including taste and aroma. Their type, consistency and aroma depend on milk origin (including animal nutrition), the fact, whether milk was pasteurized or no, fat content, bacteria and mould type, way of processing, conditions and duration of ripening [15]. Even if cheese is produced by the same people on the same recipes, but out of milk, milked in different locations or especially from different breeds, made product will be different [11].

Taste peculiarities of different cheeses as well are formed during the ripening of cheese. Different cheeses have different terms of ripening – from 2–3 days to 6 months. Cheese ripening is fermentative-microbiological process, when milk components undergo biochemical changes. At the beginning of ripening in cheese microorganisms develop rapidly. The numerical maximum of them falls on the 6–8th day, the minimum – on the 12–15th day. During this period, milk sugar is fermented, resulting in the formation of lactic, acetic, propionic and other acids. Most bacteria die at high acidity (autolysis), and their endoenzymes are released. The combined action of endoenzymes and rennet enzyme lead to the breakdown of about 60% of protein. The longer the cheese matures, the deeper the proteins break down.

The term "degree of maturation of cheese" expresses the ratio of soluble nitrogen to 100 parts of total nitrogen. During the maturation period, the value of this coefficient gradually increases. Its growth depends on the type of cheese. When soft cheeses ripen, the value of the coefficient increases rapidly (after one month by 30–35%), when hard cheeses ripen – slowly, for example, by the same amount, but only in three months.

It was found, that cheese taste and aroma are formed by different volatile compounds [3–7, 17–18, 22, 26], including volatile fatty acids, aldehydes, alcohols, sulfonyl components, esters and other components. Free fatty acids influence is prevailing. So, it was interesting to investigate taste and other physical characteristics of hard cheese, manufactured from milk of native for Ukraine local Brown Carpathian breed on different technologies and investigate volatile pictures of the cheeses to make cheese, which reveal in the best way good aroma and organoleptic qualities of native local breed products in perspective.

Materials and methods. The cheese was made on August 30 and September 1, 2019 in the conditions of a high-altitude village of Mizhhirya district of Zakarpattia region Synevyrska Polyana (height above sea level over 800 m) under the supervision of experienced cheese-maker Iryna Demyanyuk, who holds her own cheese-making school. It was decided to prepare cheese on different technologies suitable for high-altitude meadows. On August 30–31, milk for cheese was taken from Carpathian Brown cows. The affiliation to the breed was determined by the experienced specialists on its breeding according to the main phenotypic characteristics during the implementation of the FAO project for the preservation of Carpathian Brown breed in Ukraine. Milk was not pasteurized.

Cheese was prepared on 5 different technologies. Number 1 and 2 samples of cheese were prepared on August 30 at 20.00–22.00. 3, 4, 5 – from 6 to 8 o'clock in the morning on September 1. Samples were prepared outdoor at the temperature of environment 16–18°C. After the first heating, all cheeses were supplemented with rennet enzyme of Meito firm. The first and second samples were made on Swiss technologies with a first heating temperature 48°C. The second sample was made from Brown Carpathian cattle milk with fat content 3.5%. The third sample of cheese was made on the technology of Beaufort cheese preparation from milk with fat content 3.70% and 3.90%, protein – 2.98% and 3.00% with the first heating – to 33°, the second – to 54°C. The fourth sample was prepared from the milk of Brown Carpathian cows with a fat content 2.63% on Italian high-altitude technology. The fifth sample is based on Dutch technology with a first heating temperature

38°C 40–50 g of salt was used for each of the samples (dry salting). Samples 5 times during maturation were washed with saline solution.

The samples were stored for the first month at a temperature of 7.7°C and humidity of 70%. Then – 4 months at a temperature of 15°C and humidity of 46%. Last month – 10°C and 38% respectively.

Phisical and chemical characteristics of cheese were determined in Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv (Ukraine). Alternative evaluation of organoleptic peculiarities of cheese was done by cheese expert Oxana Chernova ("ProCheese", Ukraine).

The degree of maturity was determined by the most accessible method of Shilovich. It is grounded on the change of the buffering of water extract of cheese. In the process of protein cleavage products accumulation (most of them have amphoteric properties), the buffer capacity of the cheese mass increases. Substances with amphoteric properties can react both as acids and as alkalis. Mature cheese has a higher water extract buffer than young. Methodics of Shilovich on detection of degree of cheese maturity is done as follows:

1. 1.5 g of cheese is thoroughly ground in a mortar, gradually adding 45 ml of warm (45–40°C) water to obtain an emulsion.
2. After settling for a few minutes, the emulsion is filtered through a paper filter.
3. Measure 10 ml of clear filtrate into two clean flasks.
4. In one flask add 3 drops of 1% solution of phenolphthalein and titrate with a solution of caustic potassium (sodium) until a pale pink color, which does not disappear with shaking.
5. Add 10–15 drops of 0.1% thymolphthalein solution to another flask and titrate to a blue color.
6. The difference in the number of millilitres of alkali lost on titration with thymolphthalein multiplied by 100 is an indicator of cheese maturity in degrees.

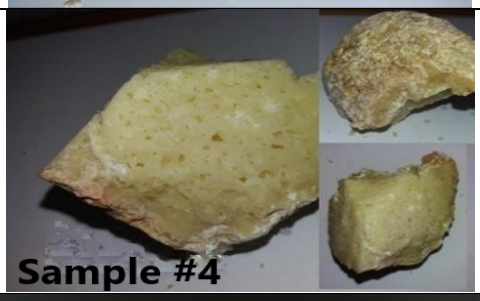
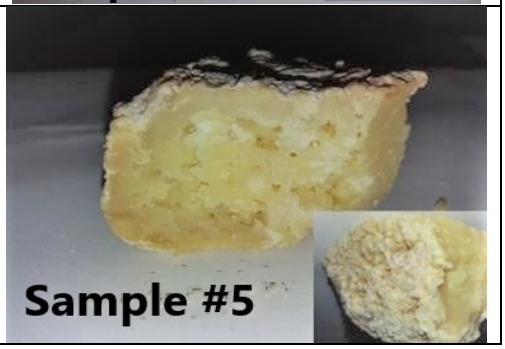
Humidity contents was detected by exsiccation method at the temperature 102 ± 2°C. Humidity contents was determined on the dry residual (the difference between the mass of sample before and after exsiccation).

The detection of fatty acid contents was carried out according to the Ukraine state standard ISO 5508–2001 "Animal and Vegetable Fats and Oils. Analyzing of fatty acid methyl ethers by gas chromatography method". Preparation of samples was done in obedience to Ukraine state standard ISO 5509–2002 "Animal and Vegetable Fats and Oils. Preparation of methyl ethers of fatty acids." Chromatographic analysis of fatty acids was carried out in the Ukrainian Laboratory of Quality and Food Safety in Agrarian Industry of the National University of Biological Resources and Nature of Ukraine, Kyjiv, at gas chromatograph Trace Ultra with FID detector and capillary column SP-2560 (Supelco). The error of the sample was calculated between two testing of the same sample.

Results and discussion. Active acidity (pH) is the index, which is rather important for cheese quality and characterizes the conditions, which are being created in the cheese [10]. Low indexes of active acidity result in rough consistency of cheese, high indexes cause brittle, fragile consistency. Active acidity of samples was in range 6.3–6.6 (Table), which is not very much satisfying, as concentration of milk acid in cheese should be in range 5.3–5.9.

Active acidity is being changed during the maturation process, but too high (lower, than 5.0) can lead to faults in the ready product. Rather high contents of salt can explain in certain cases mealy consistency of cheese, like in the first sample, though samples with even higher content of salt are not characterized with mealy consistency. The explanation can be found in the method of salt adding in different samples: at the beginning of cheese making or, when washing the cheese with salt solution.

Some physical-and-chemical characteristics of cheese from the milk of Brown Carpathian cattle

Physical and chemical indexes				
Number of sample	Active acidity (pH)	NaCl contents, %	Maturation degree on Shylovich method,°Sh	Cheese sample
1	6.5	8.4	470	
2	6.6	10	380	
3	6.6	5	110	
4	6.4	10.4	330	
5	6.3	12.4	770	

Contents of salt influenced the taste of samples and their texture. So, the first sample was characterized as “rather salt”, though the contents of salt in it was a bit lower, than in the fourth sample, in which organoleptically was detected “low contents of salt”. Latter can be explained general

low score of the fourth sample, shaded with bittery taste and “deadness” of it. The highest contests of salt are detected in the fifth sample, though it has not the lowest score on taste and texture.
It was not noticed the relation between humidity and salt contents, though the third sample was characterized with the lowest (28.86%) humidity in this case as well. The highest humidity (31.72%) was detected in the first sample. Other samples ranged between these indications. The second sample had humidity contents – 30.28%, fourth – 29.80%, fifth – 29.12%.

On the organoleptic indexes the highest score was given to third sample, the lowest – to the fourth. The first sample was admitted “not bad” and at the correction of technology. Among the advantages of the first sample were noted "spicy aftertaste of sourness" and "absence of bitterness".

This sample is also marked by a slight fruity aftertaste, which may indicate the presence of dodecalactones. Provided adjustment of cooking technology (cheese sticks to the teeth and rather salt) and maturation, this cheese can be considered as an alternative for the development of cooking technology, which reveals the properties of milk of this breed in good way. The sample, which was marked as the most suitable for the milk of the region (third), was described as "unsalted at first, but with a salty-buttery aftertaste". The advantages of the third cheese also included "satisfactory humidity", the cheese is not chipped, does not crumble or taste bitter. The broken process of cooking at the second heating and not completely satisfactory quality of milk for the first sample did not allow to reveal the advantages of this technology - the cheese sticks to the teeth, is slightly rubbery, bitterness is felt during tasting. On appearance, all cheese samples had a surface with extramural layers and a thick surface layer, the formed crust had roughnesses. All samples were characterized by a moderate taste and smell, slightly spicy. Almost all cheeses had a hard, dense and brittle consistency, only the third sample was characterized by a certain plasticity.

The brittle consistency of the samples can be explained by the low ripening temperature of the cheese and the excessive salt content in almost all samples. However, it should be noted that the colour of cheese body of the samples mainly is not pale (as in the first sample, which is a sign of oversalting), more inclined towards the deep yellow, mainly waxy, near the crust colour is more saturated, eyes, which can be caused by gas-forming microflora, are larger in the fourth and fifth samples. The latter can be not only evidence of the peculiarities of a particular technology, but also the peculiarities of the milk of cows in a given area. Uneven colouring of the samples, which is especially present in the first sample, may also be caused by salt excess. In the majority of samples there are multiple "islands of crystallization" – round spots of a lighter shade, which may indicate the maturation of the cheese. Among the disadvantages of the first sample, the cheese expert also noted the dryness and fragility of the texture, but the crystalline structure of the sample was noted as an advantage and feature inherent to aged cheeses, although all cheeses were marked with the same shelf life. That is, this technology in terms of texture is the most favourable for the milk of this region and breed. The advantage of this technology can also be considered the presence of a faint aroma of orange in the aroma composition of the sample. Improvements are likely to be made concerning the aging conditions, which have led to the presence of a petrified crust and a somewhat musty odour.

Disadvantages of the second sample, which was also prepared according to Swiss technology, include insufficient pressing time, which led to a soft, moist centre and shortcomings of aroma and crust. The third sample, which had the highest fat content and the best consistency, pattern, colour and aroma (pineapple), received the highest score among the tested. Among the disadvantages was the slightly sour smell of the crust. Taking into account, that this sample had the lowest contents of salt, it could be considered, that the better organoleptic profile of it is caused by lower contents of it, but it should be noted, that the second and the fourth samples had almost the same contents of salt, but differed in appearance and organoleptic peculiarities.

The worst score was given to the fourth sample, which was marked by a dirty grey colour of the crust, its very firm consistency, creaking when cut and musty smell. So, notwithstanding the not strictly adherence to all the required maturation conditions, the third sample technology deserves consideration for the milk of Brown Carpathian cattle, as the conditions were the same, but the third sample on organoleptic peculiarities had the highest score. So, to investigate thoroughly, what caused

the specific organoleptic profile of it, it was decided to study free fatty acids contents of the third sample and compare it to the first sample profile to make some conclusions. It was decided to do it, as it was stated [2–5, 8–9, 17, 26] that especially free fatty acids contribute to the smell and taste of cheese. It was decided to compare the fourth sample fatty acid profile with the first sample, as the first sample was the second on the good scoring after the third sample.

The third sample was characterized with lower almost by 1% (3.39%), than in the first sample (4.22%) butyric acid contents. As it is known [2, 4], butyric acid in higher concentrations can be the reason of taste faults, but the investigations on the intensity of butter [9], testified, that the higher contents of acetic, butyric and milk fatty acids up to certain concentrations caused more intense aroma. At different research it was proved, that caproic, caprylic and capric acids are the identifiers of unpleasant taste [2] and their higher contents are typical for goat's milk and cheese [4]. Investigated samples were characterized with not high contents of these acids (within 1.07–2.29% out of 19 fatty acids, detected in each sample). The third sample was characterized with higher content of capric (2.29%) and caprylic (1.14%) acids by 0.45 and 0.07% respectively. Caproic fatty acid contents was higher by 0.08% in the first sample and constitutes 2.10%. Conducted analysis of certain fatty acids, contributing to taste and aroma of investigated cheeses showed, that deeper analysis, including aldehydes, ethers, ketones and other aromatic substances' contents should be undertaken to detect the total aromatic composition of cheese to facilitate forming the best one.

Conclusions. 1. Commercialization of Brown Carpathian cattle products can rescue the breed and stop the process of its extinction. Cheese is the most suitable product for this aim.

2. Making the cheese from the milk of Brown Carpathian cattle on different technologies showed the superiority of French Beaufort technology for the milk of the breed on texture, taste and aroma of prepared cheese.

3. Physical-and-technical indexes, as well as organoleptic ones proved the oversalting of the samples, which needs correction.

4. Free fatty acids analysis of two the most suitable samples proved the necessity of deeper analysis of volatile profiles.

BIBLIOGRAPHY

1. Атамас Н. Вони дочекалися, або чому COVID-19 перший, але не останній : Web-site. URL: https://kunsht.com.ua/voni- dochekalisya/ ?fbclid=IwAR2fzxGRWozLN3BUOr-VRz01kOFk9EvaHvcnmn_mIctjwKJ2SC_rhutjb-A.

2. Боднарчук О. В. Дослідження впливу температурних режимів достигання сирів швейцарської групи на їх якість. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького*. 2011. Т. 13, вип. 4 (50), ч. 4. С. 8–14.

3. Боднарчук О. В. Дослідження якості кисловершкового та солодковершкового масла при зберіганні. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького*. 2014. Т. 16, вип. 3 (60), ч. 4. С. 11–20.

4. Галух Б. І., Драчук У. Р., Дроник Г. В., Фаріоник Т. В. Смако-ароматичні речовини бринзи, виготовленої з молока різних видів тварин. *Збірник Вінницького національного аграрного університету.* 2013. Вип. 1 (71). С. 130–135.

5. Галух Б. І., Паска М. З. Дослідження ліполітичних процесів в продуктах функціонального призначення, виготовлених з сировини Карпатського регіону. *Технологический аудит и резервы производства.* 2016. Т. 3, вип. 3 (29). С. 23–29.

6. Жукова Я., Король Ц. О., Вакуленко М. М., Малова В. В. Вплив різних культур білої плісняви на накопичення летких ароматичних сполук в м'яких сирах. *Продуктивні ресурси*. 2013. Вип. 1. С. 98–104.

7. Жукова Я., Король Ц. О., Малова В. В., Захандревич О. А. Аналіз аромату м'яких сирів з білою пліснявою з застосуванням системи «Електронний ніс». *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького*. 2013. Т. 15, вип. 1 (55), ч. 3. С. 64–69.

8. Жукова Я., Король Ц. О., Петрищенко С. Визначення інтенсивності аромату сметани в

ферментованих вершках. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького*. 2014. Т. 16, вип. 2 (59), ч. 4. С. 54–64.

9. Жукова Я., Петрищенко С., Олійніченко О. Критерії інтенсивності аромату кисловершкового масла. *Товари і ринки.* 2015. Вип. 2. С. 64–72.

10. Изменение кислотности при созревании сыра. Все о технологии молока : web-site. 2013. URL: http://milk-industry.ru/biohimiya-moloka/3217-izmenenie-kislotnosti-pri-sozrevanii-syra.html.

11. Несінова У. Його величність сир! Пані Вчителька. 2007. Вип. 3 (4). URL: http://journal.osnova.com.ua/article/2144%D0%99%D0%BE%D0%B3%D0%BE_%D0%B2%D0%B5%D0%BB%D0%B8%D1%87%D0%BD%D1%96%D1%81%D1%82%D1%8C_%D1%81%D0%B8%D1%80%21.

12. Оптовый склад элитных сыров : web-site. URL: https://cheese.kiev.ua/about_us.

13. Поліщук І. Як вибрати сир правильно : поради від сомельє. 2018. URL: https://ranok.ictv.ua/ua/2018/02/14/yak-pravilno-obirati-tverdij-sir-poradi-vid-somelye/.

14. Результати органолептичної оцінки та дегустації дослідних зразків сиру «Російський». URL: .https://studfile.net/preview/5013761/.

15. Сир. Вікіпедія. URL: https://uk.wikipedia.org/wiki/%D0%A1%D0%B8%D1%80.

16. Топ-9 корисних сирів: чим вони поживні. URL: https://portal.lviv.ua/news/2019/03/24/top-9-korysnyh-syriv-chym-vony-pozhyvni.

17. Шульга Н. М. Вплив заквашувальної мікрофлори на формування смако-ароматичної композиції твердих сичужних сирів. *Науковий вісник Львівського національного університету ветеринарної медицини та біотехнологій імені С. З. Гжицького*. 2013. Т. 15, вип. 3 (57), ч. 4. С. 143–147.

18. Bertuzzi A. S., McSweeney P. L. H., Rea M. C., Kilcawley K. N. Detection of volatile compounds of cheese and their contribution to the flavour profile of surface-ripened cheese. *Comprehensive reviews in Food science and food safety*. 2018. Vol. 17. P. 371–390. URL: https://doi.org/10.1111/1541-4337.12332.

19. FAO. What is happening to agrobiodiversity? 2020. URL: http://www.fao.org/3/y5609e/y5609e02.htm.

20. FAO. Genetic diversity of livestock can help feed a hotter, harsher world. Food and Agriculture Organization of the United Nations. 2020. URL: http: // www.fao.org/news/story/en/item/380661/icode/.

21. FAO in the 21st century. Ensuring food security in a changing world. Rome: Food and Agricultural Organization of the United Nations. 2011. URL: http:// www.fao.org/3/i2307e/i2307e.pdf.

22. Ha K., Lindsay R. C. Method for the quantitative analysis of volatile free and total branched-chain fatty acids in cheese and milk fat. *J. Dairy Sci.* 1990. Vol. 73. P. 1988–1999.

23. McDonough M. How one Parmigiano saved an ancient breed of cattle. *Culture: the word on cheese*. 2018. URL: https://culturecheesemag.com/cheese-talk/how-one-parmigiano-saved-an-ancient-breed-of-cattle.

24. Suurkula J. World-wide cooperation required to prevent global crisis; Part one – the problem, Physicians and Scientists for Responsible application of Science and Technology, February 6, 2004. URL: https://www.globalissues.org/article/171/loss-of-biodiversity-and-extinctions.

25. The breed. Consorzio Vacche Rosse: web-site. URL: https://www.consorziovaccherosse.it/en/the-breed/the-red-cows-breed/#:~:text=The%20breed, Mothers%E2%80%9D%20of%20Parmigiano%2DReggiano.

26. Verzera A, Condurso C., Ziino M., Romeo V., Todaro M., Conte F., Dima G. Free fatty acids and other volatile compounds for the characterisation of “Vastedda della valle del Belìce” cheese Acidos grasos libres y otros constituyentes volátiles para la caracterización de queso “Vastedda della vella del Belìce”, CyTA. *Journal of Food*. 2010. Vol. 8, is. 3. P. 237–243, DOI: 10.1080/19476330903450282.

27. Weaver S. Raising rare livestock breeds. 2009. URL: https://www.hobbyfarms.com/raising-rare-livestock-breeds-7/.

REFERENCES

1. Atamas, N. 2020. Vony dochekalysya, abo chomu COVID-19 pershyy, ale ne ostanniy – They waited, or why COVID-19 is the first, but not the last. Koonsht web-site. Available from: https://kunsht.com.ua/voni-dochekalisya/?fbclid=IwAR2fzxGRWozLN3BUOr-VRz01kOFk9EvaH-vcnmn_mIctjwKJ2SC_rhutjb-A. [Cited on June, 2020] (in Ukrainian).

2. Bodnarchuk, O. V. 2011. Doslidzhennya vplyvu temperaturnykh rezhymiv dostyhannya syriv shveytsars'koyi hrupy na yikh yakist' – Research on the influence of temperature regimes of maturation of Swiss group cheeses at its quality. *Naukovyy visnyk L'vivs'koho natsional'noho universytetu veterynarnoyi medytsyny ta biotekhnolohiy imeni S. Z. Hzhyts'koho – Scientific herald of Gzhytskii Lviv national university*. 13/4(50):8–14 (in Ukrainian).

3. Bodnarchuk, O. V. 2014. Doslidzhennya yakosti kysloversh kovoho ta solodkovershkovoho masla pry zberihanni – Investigations on the quality of sour cream and sweet cream butter, when stored. *Naukovyy visnyk L'vivs'koho natsional'noho universytetu veterynarnoyi medytsyny ta biotekhnolohiy imeni S. Z. Hzhyts'koho – Scientific herald of Gzhytskii Lviv national university.* 16/3(60):11–20 (in Ukrainian).

4. Halukh, B. I., U. R. Drachuk, H. V. Dronyk, and T. V. Farionyk. 2013. Smako-aromatychni rechovyny brynzy, vyhotovlenoyi z moloka riznykh vydiv tvaryn – Taste and aromatic substances of brynza, made of milk of different species. *Zbirnyk Vinnyts'koho natsional'noho ahrarnoho universytetu – Collection of scientific works of Vinnitsa national agrarian university.* 1(71):130–135 (in Ukrainian).

5. Halukh, B. I., and M. Z. Paska. 2016. Doslidzhennya lipolitychnykh protsesiv v produktakh funktsional'noho pryznachennya, vyhotovlenykh z syrovyny Karpats'koho rehionu – Investigation of lypolitic processes in the products of functional purpose, made of raw stuff. *Tehnologicheskij audit i rezervy proizvodstva – Technological audit and production reserves.* 3/3(29):23–29 (in Ukrainian).

6. Zhukova, Ya., Ts. O. Korol', M. M. Vakulenko, and V. V. Malova. 2013. Vplyv riznykh kul'tur biloyi plisnyavy na nakopychennya letkykh aromatychnykh spoluk v m"yakykh syrakh – Influence of different cultures of white mold into the cumulation of volatile aromatic compounds in mild cheeses. *Produktyvni resursy – Productive resources*. 1:98–104 (in Ukrainian).

7. Zhukova, Ya., Ts. O. Korol', V. V. Malova, and O. A. Zakhandrevych. 2013. Analiz aromatu m"yakykh syriv z biloyu plisnyavoyu z zastosuvannyam systemy «Elektronnyy nis» – *Naukovyy visnyk L'vivs'koho natsional'noho universytetu veterynarnoyi medytsyny ta biotekhnolohiy imeni S. Z. Hzhyts'koho – Scientific herald of Gzhytskii Lviv national university.* 15/1(55):64–69 (in Ukrainian).

8. Zhukova, Ya., Ts. O. Korol', and S. Petryshchenko. 2014. Vyznachennya intensyvnosti aromatu smetany v fermentovanykh vershkakh – Determination of the intensity of sour cream aroma in fermented creams. *Naukovyy visnyk L'vivs'koho natsional'noho universytetu veterynarnoyi medytsyny ta biotekhnolohiy imeni S. Z. Hzhyts'koho – Scientific herald of Gzhytskii Lviv national university.* 16/2(59):54–64 (in Ukrainian).

9. Zhukova, Ya., S. Petryshchenko, and O. Oliynichenko. 2015. Kryteriyi intensyvnosti aromatu kysloversh kovoho masla – Criteria of aroma intensity of sour cream butter. *Tovary i rynky – Goods and markets.* 2:64–72 (in Ukrainian).

10. 2013. *Izmenenie kislotnosti pri sozrevanii syra – Changing of acidity at cheese maturing.* Everything about dairy technology : web-site. Available from:http://milk-industry.ru/biohimiya-moloka/3217-izmenenie-kislotnosti-pri-sozrevanii-syra.html [Cited on July, 2020] (in Russian).

11. Nesinova, U. 2007. Yoho velychnist' syr! – His majesty cheese! *Pani Vchytel'ka – Mrs. Teacher.* 3(4). Available from: http://journal.osnova.com.ua/article/2144%D0%99%D0%BE%D0%B3%D0%BE_%D0%B2%D0%B5%D0%BB%D0%B8%D1%87%D0%BD%D1%96%D1%81%D1%82%D1%8C_%D1%81%D0%B8%D1%80%21[Cited on June, 2020] (in Ukrainian).

12. *Optovyj sklad jelitnyh syrov – Bulk store of elite cheeses: web-site*. Available from: https://cheese.kiev.ua/about_us [Cited on October 2020] (in Russian).

13. Polishchuk, I. 2018. *Yak vybraty syr pravyl'no : porady vid somel'ye – How choose cheese correctly: advice from sommelier.* Available from: https:// ranok.ictv.ua/ua/2018/02/14/yak-pravilno-obirati-tverdij-sir-poradi-vid-somelye/ [Cited on June 2020] (in Ukrainian).

14. *Rezul'taty orhanoleptychnoyi otsinky ta dehustatsiyi doslidnykh zrazkiv syru «Rosiys'kyy» – Results of organoleptic evaluation and tasting of experimental Rosiiskii cheese samples.* Available from: https://studfile.net/preview/5013761/ (in Ukrainan).

15. *Syr. Vikipediya – Cheese. Wikipedia.* Available from: https://uk.wikipedia.org/ wiki/%D0%A1%D0%B8%D1%80 [Cited on June, 2020] (in Ukrainan).

16. 2020. *Top-9 korysnykh syriv: chym vony pozhyvni – Top-9 of healthful cheeses: why they are nutritious.* Available from: https://portal.lviv.ua/news/2019/03/24/top-9-korysnyh-syriv-chym-vony-pozhyvni [Cited on July, 2020] (in Ukrainian).

17. Shul'ha, N. M. 2013. Vplyv zakvashuval'noyi mikroflory na formuvannya smako-aromatych-noyi kompozytsiyi tverdykh sychuzhnykh syriv – The influence of fermenting microflora on the forming of taste-aroma composition of hard rennet cheeses. *Naukovyy visnyk L'vivs'koho natsion-al'noho universytetu veterynarnoyi medytsyny ta biotekhnolohiy imeni S. Z. Hzhyts'koho −Scientific herald of Gzhytskii Lviv national university*. Vol. 15. – Issue 3 (57). 4:43–147 (in Ukrainian).

18. Bertuzzi, A. S., P. L. H. McSweeney, M. C. Rea, and K. N. Kilcawley. 2018. Detection of vol-atile compounds of cheese and their contribution to the flavour profile of surface-ripened cheese. *Comprehensive reviews in Food science and food safety*. 17:371–390. Available from: https://doi.org/10.1111/1541-4337.12332 (in English).

19. 2020. *FAO. What is happening to agrobiodiversity?* Available from : http://www.fao.org/3/y5609e/y5609e02.htm [Cited on July 2020] (in English).

20. 2020. *FAO. Genetic diversity of livestock can help feed a hotter, harsher world.* Food and Agriculture Organization of the United Nations. Available from: http://www.fao.org/news/story/en/item/380661/icode/ [Cited on October 2020] (in English).

21. 2011. *FAO in the 21st century. Ensuring food security in a changing world.* Rome: Food and Agricultural Organization of the United Nations, 271. Available from:http://www.fao.org/3/i2307e/i2307e.pdf [Cited on June, 2020] (in English).

22. Ha, K., and R. C. Lindsay. 1990. Method for the quantitative analysis of volatile free and total branched-chain fatty acids in cheese and milk fat. *J. Dairy Sci.*, 73:1988–1999 (in English).

23. McDonough, M. 2018. How one Parmigiano saved an ancient breed of cattle. *Culture: the word on cheese*. Available from: https://culturecheesemag.com/cheese-talk/how-one-parmigiano-saved-an-ancient-breed-of-cattle [Cited on October, 2020] (in English).

24. Suurkula, J. 2004. Worldwide cooperation required to prevent global crisis; Part one – the problem, Physicians and Scientists for Responsible application of Science and Technology, Febru-ary 6, 2004. Available from: https://www.globalissues.org/article/171/loss-of-biodiversity-and- ex-tinctions (in English).

25. *The breed. Consorzio Vacche Rosse: web-site.* Available from: https://www.consorziovac-cherosse.it/en/the-breed/the-red-cows-breed/#:~:text=The%20breed,Moth-ers%E2%80%9D%20of%20Parmigiano%2DReggiano [Cited on August, 2020] (in English).

26. Verzera, A., C. Condurso, M. Ziino, V. Romeo, M. Todaro, F. Conte, and G. Dima. 2010. Free fatty acids and other volatile compounds for the characterisation of "Vastedda della valle del Belìce" cheese Acidos grasos libres y otros constituyentes volátiles para la caracterización de queso "Vast-edda della vella del Belìce", CyTA – *Journal of Food*. 8:3237–243. DOI: 10.1080/19476330903450282 (in English).

27. Weaver, S. 2009. *Raising rare livestock breeds.* Available from: https://www.hobby-farms.com/ raising-rare-livestock-breeds-7/ (in English).

Одержано редколегією 19.04.2021 р.
Прийнято до друку 12.05.2021 р.