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The Development Of Chinchilla Fur Processing Techniques.

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ABSTRACT

Chinchilla skins underperform almost all types of fur animals to the strength properties of leather, due to the delicacy of its leather and significant loosening because of great amount of hair. It indicates low wear resistance of chinchilla fur. It shows a possibility for choosing and applicability as optimum tanning agents for low-liquid processing of chinchilla skins: aluminum potassium sulphates at 20g/100ml concentration and U.S.-manufactured aldehydic tanning agent called TanEZN at 2ml/100ml concentration. Experimental results demonstrated that the processed chinchilla skins of different coat patterns comply with the standards of the technological properties for similar fur animals, such as squirrel, etc., they are characterized by the stability of internal structure of leather, as well as sufficient plasticity.

Keywords: chinchilla skin, tanning and processing techniques

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INTRODUCTION

Nowadays, the breeding of chinchillas is a small part of fur farming but it is growing ina number of countries[1]. In one year alone, the quantity of reproductive females nearly tripled in Denmark (from 5807 in 2000 to 14 329 in 2001) [2, P.61]. The breeding of chinchillas became widespread in Poland [3, 4], Czech Republic, Slovakia, Hungary [5], Croatia, Slovenia, Canada [6], Sweden [7], Denmark [8, 9], Germany [10], Italy [11], England [12], Spain [13], Turkey [14], New Zealand [15], as well as in the countries of South America[16-18]. In 1970,the annual amount of global manufacturing of chinchilla fur skins was around 300,000and is on the rise ever since [19]. Since the beginning of 1980s, chinchilla farming reached industrial level by virtue of the owners of big fur farms with the population of over 500 females. By2007,world market capacity was over 1 mln. pieces not including growing and unsatisfied demand in China, Korea, and Japan[20].

Since 1953,chinchillas were treated extinct out in the wild[21], on the other hand, in1974, the estimated quantity of chinchillas in the wild was 10,000 [22]. There were efforts carried out to let chinchillas bred in captivity go out in the wild but there are no data about the success rate, since the animals inhabited in hard-to-reach areas. In 1975,there were discovered two separated long-tailed chinchilla colonies in the North-Central part of Chile, which were considered extinct in native habitat[23].In 2012,new chinchilla colonies were registered in the Atacama area (*Region de Atacama*/ Chile), where they were not seen in the last 50 years [24]. In Russia, chinchillas appeared in 1960 as a result of buying a hundred pairs of the animals from the USA. Since 1964 to 1972,the specialists ofAll-Russian Research Institute for Hunting Husbandry and Livestock bred over1700 animal units of chinchillas,299 of them were released in the areas of Western Pamir chains and Caucasus Minor [25]. At the present moment, there are no wild chinchillas in field use in our country, although there is data about their successful acclimatization. The complication of confirmation of it is due to the secret mode of living of these animals [26]. Researchers from many countries study biology, behavior, habitat of wild chinchillas and the way of protecting them against emerging threats [27, 28].

Chinchilla fur currently hold quite a firm place on the world fur market as a result of a good organization of the breeding of these animals [29, 30]. The conducted source analysis of foreign papers revealed that the peculiarities of animal management and fur processing techniques have an impact on the quality of chinchilla fur, as well as its pricing [31-38].

According to expert opinion, the best skins should be bigger [39, 40], their fur should be thicker and fluffier, it should be shiny [41, 42], with a well-defined veil, uniform in thickness, fur length, and coat pattern [43, 44]. Coat pattern uniformity means that both the main (dark part of the fur) and down (the white part of the fur) chinchilla fur should be solid, without shades and stains [45]. Besides that, the high quality factor for chinchilla fur is the length of the white abdominal zone and a clear dividing line from the main fur to the white zone—the narrower that zone and clearer its dividing line, the more valuable the fur is considered [46]. The colour of the belly should besnow-white, without shades and spots. Chinchilla coat pattern can be generally distinctive and quite often significantly differ from a nature-coloure done; its colour is primarily driven by fashion preferences. To escalate product pricing, fur farmers developed chinchillas of different colours and shades: white, black, brown, silver, etc [47]. In particular years, lighter fur was more popular, then later relatively blue fur was a success; at the moment, originally coloured fur is the most expensive, including “black velvet” [48]. In this regard the key aspect of animal breeding is developing chinchillas with new, even unexpected fur colours [49].

With the advent of new technology of fur processing, the fur becomes an easy-to-handle, multifunctional material which can be wornall year round. The ability to experiment with fur extended its usability limits, including the usage by widely renowned couture houses [50]. The demand for chinchilla fur goods increases every year, leading designers all over the world present both chinchilla fur coats and decorative chinchilla fur trim, upon that such coats can cost $6,000-$30,000[51].

According to the opinion of Russian fur farming experts, caged-animal farming is the most profitable field in animal breeding industry[52]. Fur manufacturing in Russia reached its uppermost production development in 1970-1980s, producing over 12 mln. undressed fur annually, up to 40% of global production with up to 80% profitability. The major part of fur material was exported, which made the industry a very important source of foreign trade proceeds [53]. By 2012, the breeding stock of fur animals had decreased to 21.1 % compared to the breeding stock in 1990 (from 2059,7 thous. animal units in 1990 to 434,4 thous.

animal units in 2012) [54]. The contraction in manufacturing of domestic fur resulted in a situation where,by 2013, 70% of fur sold on Russian markets was of foreign origin (at material values of €200-250 mln) [55]. Under current conditions, domestic fur farming loses major part of the local market to foreign suppliers and does not compete on global markets. Lack of scholarly insight on rational management, breeding peculiarities, coat pattern selection, and fur processing prevents the development of industrial chinchilla breeding, as well as skin and fur manufacturing.

It is commonly known that the quality offur and skin production significantly depends on technological procedures of fur processing [56], as well as onprecise maintenance of processing methods defining the nature, size, and amount of possible defects [57]. After processing the fur material, its structure and the features of derm changes significantly: collagenous fibersget shredded into more elementary fibers with subsequent securing of obtained changes [58]. As the result, the skin becomes soft, plastic, water-resistant, heat-resistant, proof against microorganisms, which means that is becomes suitable for producing fur outfits [59]. Technological procedures for the transformation of preserved fur [60] into a semi-product consist of numerous chemical, physicochemical, and mechanical operations; preparation, processing, and finishing stages can be distinguished among those procedures.

Most factors for physical mechanical and technological properties of fur skins depends on the selected methods of processing [61]. Never the less, to the present moment, there are no regulated techniques for chinchilla fur processing in Russia, while foreign patents do not disclose technological methods due to their commercial value [62]. Therefore, in order to determine important application properties of the skins, wetested experimental techniques of processing based on the technology adopted for the types of similar fur animals in skin and hair covering [63], including ermine, weasel, squirrel, yellow weasel, mountain weasel, hare, rabbit, and muskrat.

MATERIALS AND METHODS

As *subject* of research we chose the skins of 7-8-month-old chinchillas of different coat patterns. We chose the most popular coat pattern out of a great variety of chinchilla colour types called “standard”, the darkest and most commercially viable one called “black velvet”, the lightest one called “white Wilson”, as well as “beige” and “violet” which hold a relatively intermediate position in chromatic scale. In order to perform experimental research we collected 18 undressed skins of chinchillas of each chromatic type from the farms from different regions of Russia. Chinchilla skin quality was defined on the following stages: 1) raw material, 2) after preserving through flint-dried method, 3) after processing. For research purposes there was an experimental scheme developed, including comparative assessment of quality performance of chinchilla fur skins before and after processing.

RESULTS OF INVESTIGATION

The algorithm of technological processing of skin of chinchillas included the following stages: softening → fleshing → pickling → ageing → tanning → ageing → greasing → drying → drumming → breaking → drumming.

We offered the scheme forlow-liquid processing of chinchilla fur, which is about the replacement of all dipping operations with pasting ones. The developed scheme for low-liquid processing of chinchilla furconsists of the following operations.

- *Trimming:* removing unworkable parts of skin.
- *Softening:* processing raw material in water or other solutions for watering proteins of leather, removing preservative agents and impurities intended to bring the raw material into a state close to slaughter warm condition. It is performed on a table for softening with the help of a pulverizer and a brush through the pasting method at air temperature at 18-20ºC. Wetting is conducted five times within 4 hours. In the course of softening, dirt and blood is removed with water solution at 30ºC temperature, which contains*NaCl*at20-30g/l concentration. In order to accelerate the process, a surface-active agent (SAA) is used (*LevelP*)at 0.1 ml/l concentration. After softening, the skins are drained, excessive moisture gets removed; the next stage is fleshing.

- *Fleshing :*removing mechanically subcutaneous tissue, flesh lumps, and fat. The fleshing of well-moistured chinchilla skins is conducted manually with the help of a dull knife.
- *Pickling:* processing skins inacid and neutral salt solution. In acid solutions, derm's protein sex p and, become loose, and in some cases hydrolyze. In the presence of salt, collagens do not expand. Pickling enablesd is integration of skin covering and withdrawal of allnon fibrous proteins. Pickling is performed through pasting method with water solution at 40g/l concentration of *NaCl* and 8g/l concentration of acetous acid being an electrolytic fluid and having a leavening effect, while the salt being a dehydrating agent at 18-20ºC. The wetting of the skins is performed with a brush three times every three hours.
- In order to reduce the duration of the pickling stage, a procedure called *ageing* is used. Dampened skins should be piled, with the fur inside. The acid absorbed with the skin covering continues to have the leavening effect, which enables the increase of the plastic properties of the skin covering. Experiments proved that the duration of the ageing stage is 14 hours.
- Pickled skins are not stable to humidity which can caused pickling in case of contacting the skin covering. Free acid between structural elements gradually destroys the skin covering, resulting in the loss of productive efficiency of the skins. In order to avoid this, the skins undergo tanning after the pickling stage.
- *Tanning* represents the exposure for tanning agents in order to increase thickness, width, and hardness of leather, elasticity and enhancement of the outer look of the hair. It is performed through pasting method with organic and inorganic tanning agent sat different concentration levels. As effective agents for tanning without violating ecological standards, we chose water solutions of *NaCl*at 15g/l concentration with *Level P*SAA at 1ml/l concentration to accelerate the speed of the operations, and the following tanning options:

1. inorganic tanning agent in the form of aluminum potassium sulphate at 10g/100ml concentration;
2. *aluminum potassium sulphate* at 15g/100ml;
3. *aluminum potassium sulphate* at 20g/100ml;
4. U.S.-manufactured organic (aldehydic) tanning agent *TanEZN*at 1ml/100ml concentration;
5. *TanEZN*at 1.5ml/100ml concentration;
6. T*anEZN*at 2ml/100ml concentration;
7. Russian-manufactured organic (aldehydic) tanning agent called *Aldegid-M* ("Альдегид-М")at 0.5ml/100ml concentration;
8. *Aldegid-M*at 0.75ml/100ml;
9. *Aldegid-M* at 1ml/100ml.

- After applying the tanning agent, repeat *ageing* to achieve a more equal distribution of the tanning agents.
- Next stage is to apply the pasting method for *greasing*, which means processing the leather of the fur skins with grease and fat emulsions to enhance their plasticity and water-resistance. "*Effektol*" ("Эффектол") is used for this purpose of dipping and pasting methods of greasing, it is mixed with boiling-hot water calculated as 50ml of the substance with 100ml of water. The greasing is conducted twice every two hours, then repeat the ageing stage.
- Next stage is *drying*, which means removing excessive moisture from the skins at27-30°C temperature. The skins should be dried while spread out on a frame. After the drying, the skins should be dipped and staked in different directions.
- After the drying, *the drumming* of the skins is conducted in a special rolling drum at a speed of 15-20 rounds per minute during an hour. The drumming is performed to clean the skins from excessive greasing agents and impurities with the use of sawings; the amount of sawings should be 300% from the skins' weight. Add 100gof sawings for every4ml of water, 8gof a substance for drumming leather called "*Gamma-6*"(Гамма-6) and 10g of a substance for drumming hair called "*Gamma-7*"(Гамма-7).
- After the drumming, perform a procedure called *breaking* to achieve greater softness and plasticity of the leather.
- Then repeat the *drumming.*

Chinchilla skin semi-product with beautiful natural coat pattern should not undergo a colouration, instead the product is sent to finishing operations after the drying to finalize the processing cycle. The finishing

operations are essential for the transformation of chinchilla fur with matte coat with impurities and hardened leather due to the drying stage into a flexible semi-product with clean, shiny, and fluffy hair [64]. The finishing operations consist in humidifying to provide the skins' plasticity; in the drumming of the skins to clean the hair from the grease, and impurities in the drums with sawings, after this operation the skins should be shaken out to remove the sawings; then comes the breaking stage to soften the leather, the cleaning of the semi-product through dedusting; then comes the dressing of the hair manually to remove clotted and intermingled hair, the remains of the sawings and dust for better silkiness, shining, and wealth of the hair.

The performed processing of chinchilla skins allows achieving a semi-product with the necessary elasto plastic properties and good marketable condition of the leather and the hair.

DISCUSSION

Based on the experimental processing of nine options with the use of tanning agents of different origin and concentration, the quality of the obtained chinchilla fur samples was assessed according to the following readings: moisture content, fat content, leather cure temperature, and *pH* of water extract of the leather.

Leather cure temperature characterizes the degree of skin tanning as the index of the structure of leather. With increasing leather cure temperature, the leather plastic properties decrease. This is the reason why certain degree of tanning and respective leather cure temperature are allowed for each fur semi-product. According to specifications, leather cure temperature for squirrel skin should not be lower than 55ºC, for yellow weasel, mountain weasel, ermine, and least weasel skin: not lower than 60%, for muskrat skin: not lower than 65% [65-68].

Studies indicate that chinchilla skins processed with aluminum potassium sulphate are characterized by high leather cure temperature level (from 51°Cto 56°C), which indicates the stability of internal structure of leather of the semi-product (Table 1). During the tanning with the use ofthe aldehydic tanning agent called*TanEZN*, the best measurement of the leather cure temperature at 58°Cwas obtained at 2ml/100ml concentration. During the tanning with the use of the aldehydic tanning agent called "*Aldegid-M*",the best measurements of the leather cure temperature at 52°Care specific to the concentration of 1ml/100ml. Comparative analysis indicates that aluminum potassium sulphate agents are preferable as tanning agents according to the index of the leather cure temperature at 20g/100ml concentration (56°C), as well as the aldehydic tanning agent called *TanEZN*at 2ml/ 100ml concentration (58°C).

Table 1: Leather cure temperature and*pH*of water extract of leather of the processed chinchilla fur

Tanningoptions	Leather cure temperature, ºC	pHof water extract of leather
Aluminum potassium sulphate 10g/100ml	51	4.2
Aluminum potassium sulphate 15g/100ml	54	4.1
Aluminum potassium sulphate 20g/100ml	56	4.0
TanEZN 1ml/100ml	48	4.2
TanEZN 1.5ml/100ml	50	4.3
TanEZN 2ml/100ml	58	4.2
Aldegid-M 0.5мл/100ml	46	4.5
Aldegid-M 0.75мл/100ml	48	4.3
Aldegid-M 1ml/100ml	52	4.3

The research of*pH*of water extract of leather indicted that the chinchilla fur samples in all the tanning options are characterized by weak acid medium, concurrently the degree of*pH*of water extract is measured from 4.0 to 4.5 units, which meets regulations for fur semi-products (*pH*of water extract of leather for squirrel, yellow weasel, and mountain weasel skins should not be less than 4;*pH* of water extract of leather forermine

and least weasel skins should not be less than 3; the range of*pH* of water extract of leather for muskrat skins should be from 3.5 to 7.0) [65-68].

The conducted analysis allows us to state that leather cure temperature of chinchilla fur significantly increases with the increase of the tanning agent concentration; optimum concentration for aluminum potassium sulphate solution scan be calculated as20g/100ml, for *TanEZN* - 2 ml/100 ml, for *Aldegid-M*-1ml/100ml; the degrees of *pH* of water extract of leather for all the experimentally processed chinchilla skins meet the standards for fur semi-products obtained from similar animal species (ermine, least weasel, yellow weasel, mountain weasel, muskrat, squirrel) [65-68].

The nature of tanning and filling substances influence the level of moisture in fur skins. According to specifications, the produced fur of similar types of fur animals should contain no more than 14% (moisture content in leather of the processed skins of ermine, least weasel, yellow weasel, mountain weasel, muskrats, squirrel should not exceed 14%) [65-68]. Moisture content alteration have an impact on the square, width, breaking tension, compression strength, elastic properties of the fur, etc.

Obtained results of the analysis indicate that moisture content in leather of the processed chinchilla skinsin all the tanning options of interestis measured in the range from 6.6% (with the use ofT*anEZN* at 1ml/100ml) to 9.4% (with the use of *Aldegid-M* at 1ml/100ml), which meets the standards (no more than 14%) for fur semi-product of similar types of fur animals (Table 2). Therefore, since leather is less elastic at lower level of moisture in a fur semi-product, it obstructs further processing. According to this measurement it is more efficient to use aluminum potassium sulphate at 20g/100ml concentration (moisture contentis 8.3%); *TanEZN* 2ml/100ml (8.4%),and*Aldegid-M* at 1ml/100ml (9.4%).

Table 2: Amount of moisture and fat content in the processed chinchilla fur

Tanningoptions	Amount of moisture, %	Fat content, %
Aluminum potassium sulphate 10g/100ml	7.6	20.7
Aluminum potassium sulphate 15g/100ml	8.1	16.3
Aluminum potassium sulphate 20g/100ml	8.3	18.0
TanEZN 1ml/100ml	6.6	19.9
TanEZN 1.5ml/100ml	7.9	20.5
TanEZN 2 ml/100ml	8.4	17.9
Aldegid-M 0.5ml/100ml	7.9	20.9
Aldegid-M 0.75ml/100ml	8.2	21.7
Aldegid-M 1ml/100ml	9.4	15.9

According to specifications,weight percentage of unconnected greasy substancesinleatherof squirrel skins should not exceed 20%, for muskrat skins it should be in the range of 10-25% [65-68]. Although not all the samples obtained through the use of *aluminum potassium sulphate* at 10g/100ml concentration (20.7 %), *TanEZN* at 1.5ml/100ml concentration (20.5%), *Aldegid-M*at 0.5ml/100ml concentration (20.9%) and 0.75ml/100ml concentration (21.7%) meet the given standards. Relatively high content of fat in the processed chinchilla fur skins is obtained due to the pasting method of technological processing, to a certain extent it preventedthe washing away the substance from the leather.

Only chinchilla fur skins processed with the use of *aluminum potassium sulphate* at 15g/100ml and 15g/100ml, *TanEZN* at 1ml/100ml and 2ml/100ml, *Aldegid-M* at 1ml/100ml conform to the standards for fur semi-products of similar animals by the fat content not exceeding 20%.

CONCLUSION

On the strength of all the aspects defining the quality of the processed chinchilla fur skins, it may be concluded that there is a possibility for choosing *optimum tanning agents*for low-liquid skin processing

andapplicability as tanning agents: *aluminum potassium sulphates* at 20g/100ml concentration and U.S.-manufactured aldehydic tanning agentcalled *TanEZN*at 2ml/100ml concentration.

According to the analysis of the properties of the processed chinchilla fur skins of different coat patterns, it was proven that they comply with the standards for similar fur animals, they are characterized by the stability of internal structure of leather, as well as sufficient plasticity. Although according to the measurements of leather strength and stretch elongation of chinchilla fur skins concede almost all the other fur animals, because leatherof chinchilla fur skins is very thin and significantly loosen by a big amount of hair. The selection directed to the growth of the thickness of chinchilla skin covering provides betterdurability of this animal's fur.

As a result of this experimental research, it was demonstrated that according to the technological properties, the processed chinchilla fur skins of different coat patterns comply with the standards for similar fur animals, such as squirrel, etc. Although according to the strength properties of leather,chinchilla fur skins underperform almost all types of fur animals due to the delicacy of its leather and significant loosening because of great amount of hair. It indicates low wear resistance of chinchilla fur.

REFERENCES

[1] Novikov MV. Veterinary medicine, animal science and biotechnology. 2015; 2: 23-32.
[2] The welfare of animals kept for fur production/ Report of the Scientific Committee on Animal Health and Animal Welfare. Health & Consumer Protection Directorate-General, European Commission, 2001.
[3] Barabasz B. Chinchillas: breeding and management. PWRiL, Warszawa, 2001.
[4] Polasik D. Electronic Journal of Polish Agricultural universities. 2013, 16 (4): 02.
[5] Lanszki J. Scientifur. 1999, 23 (4): 267-270.
[6] Chinchilla. Council of livestock production in Quebec, Quebec, 1974.
[7] Felska-Błaszczyk L, Brzozowski M. ArchivTierzucht. 2005, 48 (5): 494-504.
[8] Christensen AA. Practical Chinchilla breeding. Furfarm «Jørgensminde», Frederikshavnk, 1989.
[9] Pedersen VV. Dansk pelsdyravl. 1999, 62 (12): 548-549.
[10] HaferbeckE. DeutchePelztierzuchter. 1983, 57: 148-149.
[11] Ambrosini G. Chinchilla: ethology, breeding, pathology, marketing, studies and research. New press, Como, 1984.
[12] Grant M. British chinchilla breeding. Fur and Feather, Idle, 1961.
[13] Capello V. La chinchilla. Editorial de Vecchi, Barcelona, 1999.
[14] Akinci Z, Poyraz Ö, Onbaşilar E. Turkish Journal of Veterinary and Animal Sciences. 2005, 29 (2): 381-384.
[15] Environmental impact assessment: farming chinchilla in New Zealand. Animal Health Division, Ministry of Agriculture & Fisheries, Wellington, NZ, 1985.
[16] Antonio S, Velho JP, Carvalho PA, Backes AA, Sanchez LM, Velho IM. Ciência e Agrotecnologia. 2007, 31 (2): 479-484.
[17] Fellenberg P, Cumsille M. Manual slaughtering of chinchilla for the obtaining of the skin and the flesh. Pontificia Universidad Católica de Chile, Santiago, 2006.
[18] Linden AR. Creating commercial chinchillas. Agropecuária, Guaíba, Brazil, 1999.
[19] Romanov-Ilyinsky SV. Chinchilla. Forest industry, Moscow, 1982.
[20] Barabasz B. Bulletin of VOGIS. 2007, 11 (1): 115-121.
[21] Maryañski JM, Nielsen A. Archaeofauna. 2015, 24: 225-237.
[22] Heinrich D. Chinchillas/ In: Grzimeks Het leven der dieren. Het Spectrum, Utrecht, The Netherlands, 1974 (XI). pp.477-483.
[23] Villalobos Maturana HE, Rodríguez Muñoz JA. Effect of environmental improvements on the availability of food for populations of *Chinchilla lanigera, Mol*. Universidad de Chile, Santiago, 1984.
[24] Valladares P, Zuleta C, Spotorno A. Gayana. 2014, 78 (2): 135-143.
[25] Kiris I. B. Long-tailed chinchilla biology. Thesis PhD, VNIIOZ Centrosoyuz, Kirov, 1973.
[26] Shumilina NN, Larina EE, Novikov MV. Prospects of farming: the breeding of chinchillas. MGAVMB, Moscow, 2018.
[27] Dzierzanowska-Góryn´D, Skowron U. ZycieWeterynaryjne. 2013, 88 (1): 47-50.
[28] Deane AL, Lansdale CA. Observation on the behavior of wild chinchillas (*Chinchilla lanigera*). Auco, Chile: Save the Wild Chinchillas, Inc, 2018.

[29] Laabs M. Chinchillas: *Chinchilla lanigera*. Natur und Tier-Verlag, Münster, 2010.
[30] Koodziejczyk D, Adamczyk K, Gontarz A, Socha S. RocznikiNaukoweZootechniki. 2013, 40 (2): 133-144.
[31] Łapiński S, Lis MW, Wójcik A, Migdał Ł, Guja I. Annals of Animal Science. 2014, 14 (1): 189-195.
[32] Rees RG. Journal of Small Animal Practice. 2008, 4 (3). 213-225.
[33] Genta N. Manual modern breeding and exploitation of the chinchilla. Hemisferio Sur, Buenos Aires. 1987.
[34] González C, Yáñez JM, Tadich TA. Animals. 2018, 8 (9): 144.
[35] Nistal AJ, Zapata M, Bianchi F, Miranda J, Frana E, Masso RJ. AnalectaVeterinaria. 2013, 33 (1): 5-9.
[36] Ponzio MF, Busso JM, Ruiz RD, Cuneo F. Animal Welfare. 2007, 16 (4): 471- 471.
[37] Schwab GR. Raising chinchillas for profit. Meredith Press, NY, 2010.
[38] Świecicka N, Zawiślak J, Kubacki S, Gulda D, Drewka M, Monkiewicz M. Polish Journal of Natural Sciences. 2012, 27 (1): 31-39.
[39] Aleandri F. Breeding and marketing of the chinchilla. Buenos Aires, 2002.
[40] Pérez Concha P. Effects of the domestication of the chinchilla in Chile (*Chinchilla lanigera*) on some morphological and genetic indicators. Universidad de Chile, Santiago, 2004.
[41] Lanszki J, Allain D, Thébault RG, Szendrő Z. Scientifur. 2000, 4: 168-173.
[42] Novikov MV. Morphological structure of hair of chinchillas skins. Proceedings "Questions of veterinary and veterinary biology". MGAVMB, Moscow, 2011, 7: 251-255.
[43] Novikov MV. Leather and footwear industry. 2009, 5: 42-43.
[44] Sulik M. Pelt quality as a criterion of Poland's chinchillas (*Chinchilla laniger M*.) herd improvement. AR Szczecin, rozprawy, 2003. pp.223.
[45] Novikov MV. Features of some of the commercial properties of the pelts of chinchillas. Proceedings "Actual problems of commodity science of raw materials and products of animal origin, industrial and food products, ecology". MGAVMB, Moscow, 2009: 27-30.
[46] Novikov MV. Veterinarijaikormlenie. 2009, 6: 113-114.
[47] Cappelletti CA, Rozen FM. Scientifur. 1995, 19 (2): 125-128.
[48] Socha S, Koodziejczyk D, Gontarz A. Acta ScientiarumPolonorum: Zootechnika. 2004, 3 (1): 77-88.
[49] Novikov MV, Shumilina NN. Vavilov Journal of Genetics and Breeding. 2015, 19 (3): 292-295.
[50] Kiryanova EG, Guseva MA, Andreeva EG, Novikov MV. The study of the decorative properties of fur semi-finished product for innovations in the material selection of garment. Proceedings "Innovative solutions in the science of commodities of raw materials, production and recycling secondary resources of groindustrial complex". MGAVMB, Moscow, 2017: 39-43.
[51] Guseva MA, Andreeva EG, Petrosova IA, Zaretskaya GP. Prospects for the development of the consumer market of fur products in RussiaюIzvestiyaVysshikhUchebnykhZavedenii, SeriyaTeknologiyaTekstil'noiPromyshlennosti. 2018 (1): 189-191.
[52] Parkalov IV. Fur animals in the environment of natural habitats and the prospect of cell farming in modern conditions. Nestor-Story, St. Petersburg, 2006.
[53] Development of captive fur farming in the Russian Federation for 2013-2020/ Sectoral Target Program of the Ministry of Agriculture of Russia (04.12.2013, N450).
[54] Novikov MV. Analysis of the current state of development of chinchilla breeding in Russia. Proceedings "Questions of veterinary and veterinary biology". MGAVMB, Moscow, 2012, 8: 250-259.
[55] Guseva MA, Zaretskaya GP, Petrosova IA, Goncharova TL, Mezentseva TV, Andreeva EG. Market research of fur products in Russia. Bulletin of the technological university. 2016, 19 (6): 102-107.
[56] Shoots B. Chinchilla pelting & handling. Shoots Chinchilla Ranch, Westerville, Ohio, 1987.
[57] Novikov MV. Development of methods for assessing the quality of chinchilla skins and improving their production processes. Thesis PhD, MSUDT, Moscow, 2010.
[58] Novikov MV, Reusova TV. Design and technology. 2014, 43 (85): 41-50.
[59] Patent 2588984 RU Novikov MV, Shcherbakova AV. Method of tanning fur skins, 2014.
[60] Novikov MV. Scientific Journal of KubSAU. 2015, 111: 1182-1192.
[61] Novikov MV. Leather and footwear industry. 2009, 4: 42-43.
[62] Orietas JN. The technology of tanning and processing chinchilla and other species of fur skins. ARISTON Techniques, Delmar, NY, 1995.
[63] Pavlova NR. The structure and variability of the skin and hair of a chinchilla (Chinchilla laniger Molina): Thesis PhD, Lomonosov MSU, Moscow, 1971.
[64] Novikov MV, Shcherbakova AV, Ryabko BB. Innovative approaches to the processing and decoration of leather raw materials and semi-finished products. Proceedings "Methodology and practice of modern commodity science: Actual issues and ways to improve". MGAVMB, Moscow, 2014: 140-146.

[65] State standard 11106-74 Skins of muskrat tanned. - Moscow, 1985.
[66] State standard 12581-67 Skins of kolinsky and alpine weasel tanned. Moscow, 1988.
[67] State standard 12780-67 Skins of squirrel tanned. Technical conditions. Moscow, 1999.
[68] State standard 12804-67 Skins of ermine and least weasel tanned of natural and dyed. - Moscow, 1999.