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SHORT-TERM HIDES PRESERVATION USING AIR CHILLING

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SUMMARY

There were tested temperature regiemes of hides chilling at atmospheric pressure and in vacuum used for hides preservation. Raw materials treated at temperatures just above zero (0-5°C) had higher qualititative characteristics.
For the developed method evaluation and analysis physico-chemical, microbiological and hystological characteristics of chilled raw materials were tested.
During hides storage water content decreased by 3.0-4.4%; pH of water extract lowered by 13-13.7%; free ammonia content increased from 0.01 to 0.11mg%; hides weight changed by 3.0-4.4%; aerobic microflora content increased from $4.5x10^6$ to $1.2x10^8$ per 1 cm^2 of hide's surface; psychrotrophic microorganisms amount increased from $2.5x10^5$ to $5.4x10^7$ per 1 cm^2. Organoleptical characteristics of hides changed nonsignificantly. Hystological tests did not show changes of microstructure in derma papillary and reticulum layer of chilled hides as compared to the microstructure of raw hides.
Hides chilling allowed to maintain the native structure of raw hides for 7 days; to exclude the use of salt for preservation; to decrease price cost of raw hides processing and while using vacuum to intensify the process of energy saving, and also to increase the quality of raw hides and finished leather goods.

INTRODUCTION

The main task of hides preservation technology is to maintain maximally the natural microstructure of skin tissue. Hides preservation methods used in practice(brining, dry salting, salting/drying) though providing raw hides prolonged storage do not allow to maintain native structure of hide.
During last years there was a tendency to short-term hide preservation processes development including the methods of chilling. It is known that at hides chilling leather raw materials quality is maintained for a certain period of time due to autolytical and bacterial processes inhibition (1).
Chilling less affects the composition of raw materials protein fraction and influences positively collagenous structure of skin tissue, increases the finished product quality and allows to exclude defects on hides appearing at traditional treatment using salting (2).
Studies aimed at the establishment of possibility of short-term hides preservation at temperatures just above zero at atmospheric pressure (in air medium) and in vacuum are done. This will allow to provide maintenance of the natural structure and original properties of raw materials.

MATERIALS AND METHODS

Beef hides, washed and cleaned from meat residue on hides, served as the object of testing. Investigations were made using the hides of animals of the following weight groups: 17-19 kg, 21-23 kg, 25-30 kg and above 30 kg.
The following parametres were determined: water content (3), water extract pH (3), extracted ammonia content (4), total microbial load (5), microstructural changes (6), raw materials quality, tested organoleptically(state of flesh surface, colour, odour, hair holding by hide).
Samples were obtained using the method of assimetric fringe to exclude the influence of hide topography on each sample (7).
Hides were chilled in the following way. Trimmed beef hides, not later than 3 hours after dehiding, were hung up on hooks of a conveyor passing through a chilling chamber with temperature of 0-5°C. (In cold seasons the chamber was chilled by the method of outer air discharge using air duct and ventilator, in summer - with the help of air cooler). While passing through the chamber hides were chilled to the temperature of 7-8°C. To determine the time of keeping hides in the chamber thermometers were installed in the inlet, centre and outlet of the chamber. Changing conveyor rate the required regiemes of chilling were determined. To find out storage period for chilled hides they were put into containers and delivered to a chilling chamber with the same regiemes. To maintain the required temperature of hides thermometers were installed in stacks and the thermal regiemes were controlled.
At vacuum chilling the following parametres were determined: initial temperature for each hide layer; water content; decrease of pressure in processing zone; total chamber pressure; temperature on condensation surface. Three thermocouples were introduced into the sample of hide (one - on the surface, two - into the sample); hide was placed into the vacuum chamber on a netty pallet in a stretched state. Using a vacuum pump discharge was established; potentiometer was switched on to record raw materials temperature parametres change. When the given parametres of beef hides were achieved the system of vacuum establishment and maintenance was switched off; the chamber was decompressed.
To obtain significant data the results were statistically analysed using the methods of dispersion and correlation analysis; Fisher criterion, characterizing the relation of mean square of determined parameter deviations to mean square of deviations caused by measurements errors was used. Computer "Iskra-1256" was used for calculations. Repeatability of tests was five-fold and of results - three-fold.

RESULTS AND DISCUSSION

Studies into beef hides chilling process were made at raw hides initial temperature of 20-24°C that corresponded to the temperature of hide after fleshing. At air chilling hides were chilled to 7-8°C for 1-2hrs at continuous air circulation in a chamber. Chilling rate depended on the temperature of the introduced air; temperature regieme was maintained automatically. Hides state was controlled using thermocouples distributed in three positions(upper, medium and lower) along hide height at air chillingand along hide thickness at vacuum chilling. Obtained results analysis showed that hides chilling rate depended only on the rate of discharge establishment in a chamber.

While hides storage physico-chemical, microbiological and hystological parametres of raw hides treated in air medium at temperatures just above zero were investigated. Besides raw hides exposed to short-term preservation by chilling were evaluated organoleptically.

Physico-chemical characteristics of chilled hides are given in Table I.

As it is seen from the given data water content for chilled hides has changed during storage in average by 3.0-4.4% for the samples of all weight groups.

To exclude the influence of raw hides initial quality on the final characteristics a three-factor dispersion analysis was used taking into account the following three factors: weight group, storage period and tests repeatability. Results of the analysis showed that storage period most significantly influenced water content(FR-412.9; FT-2.21 at n=27 and f=3), i.e. water content decreased with storage time increase. Level of water extract pH lowered by 13-13.7% (FR-106.9; FT-2.32 at n=36 , f=3) that was due to partial development of autolytic processes in skin tissue. Free ammonia content increased, and the NH_3 value of more than 0.09mg% testified to initial changes of raw materials quality. Chilled hides weight decreased during 20-days storage period by 3.0-4.4%; weight change immediately after chilling, during the 1st hour, was 0.9-1.2% as compared to non-treated raw materials weight.

Organoleptical analysis results showed that change of flesh surface condition from normal to clummy took place by the 11-12 day of storage period; slightly specific odour appeared by the 15-16 day; colour changed from whity-pink to yellow by the 14-15 day; hair separation appeared by the 16-18 day; organoleptical characteristics of non-treated hide sharply diminished after 24 hours storage.

Total microbial load of raw hides, amount of aerobic, psychrophylic microorganisms, yeasts and moulds were determined. The data are given in Table 2.

From the given data it is seen that total amount of mesophylic microorganisms at the first day of storage has been millions of cells per 1 cm^2 of surface for all samples. Amount of microscopic fungi diaspores was no more than 30 per 1 cm^2. Tested samples contained tens of thousands of yeasts per 1 cm^2. After 2 days storage growth of aerobic microorganisms was marked. Content of microscopic fungi diaspores did not change significantly during the whole storage period and varied in the range of 10-130 diaspores per 1 cm^2. Yeasts cells died during storage; probably their growth was inhibited by the growth of other microorganisms; their amount was 10^3-10^4 cells/cm^2 by the 20th day of storage.

Proteolytic microorganisms causing full diffusive dilution of gelatine were the dominating.

Hystological tests aimed at the comparative study into microstructural changes in hides chilled and stored at temperatures just above zero were made.

The samples of non-treated beef hides after 3 hours dehiding served as the controls. Fresh hides microstructure is shown in Fig. 1 and 2; microstructure of hides chilled and stored at 5°C for 7 days is shown in Fig. 3 and 4.

Hystological investigations showed that there were no changes in microstructure of derma papillary and reticulum layer of chilled hides as compared to the microstructure of fresh hides.

CONCLUSIONS

Based on the data of physico-chemical, microbiological and hystological investigations, of raw materials organoleptical evaluation, and on the results of statistical analysis it was found that the rational temperature regiemes for beef hides chilling using atmospheric pressure or vacuum was raw hides treatment at 5°C.

As the result of investigations it was determined that raw hides treatment and storage at temperatures just above zero allow to maintain hides quality for 7 days. Half-finished leather goods produced from chilled beef hides testified to the efficiency of the proposed method; products quality corresponded to standard requirements.

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Table I. Beef chilled hides physico-chemical characteristics during storage

Storage time, days	Water content, %		pH level		Ammonia content, mg%		Weight change, kg	
	x	s	x	s	x	s	x	s
I	68.78	0.05	7.12	0.75	0.01	0.1	17.87	0.2
3	68.45	0.10	7.09	0.55	0.01	0.1	17.54	0.3
5	67.63	0.10	6.75	0.75	0.02	0.1	17.31	0.2
7	66.91	0.06	6.65	0.70	0.03	0.2	16.97	0.3
9	66.57	0.06	6.55	0.65	0.03	0.1	16.84	0.4
11	66.27	0.05	6.45	0.75	0.04	0.05	16.82	0.4
13	65.95	0.05	6.35	0.10	0.04	0.2	16.80	0.6
15	65.52	0.03	6.30	0.50	0.05	0.1	16.74	0.4
17	65.09	0.10	6.25	0.40	0.08	0.3	16.71	0.3
20	64.65	0.08	6.15	00.65	0.11	0.2	16.70	0.2

Table 2. Chilled hides microbiological characteristics during storage

Storage time days	Microbial load/1cm^2 of beef hide surface							
	Aerobic, mesophylic		Psychrotrophic		Moulds		Yeasts	
	x	s	x	s	x	s	x	s
I	$4.5x10^6$	6.1	$2.5x10^5$	1.8	20	0.1	$2.3x10^4$	1.2
3	$8.2x10^6$	1.7	$2.6x10^6$	2.0	80	0.05	$2.4x10^4$	0.9
5	$1.2x10^7$	2.3	$4.3x10^6$	2.2	70	0.08	$1.5x10^4$	0.8
7	$2.6x10^7$	7.2	$5.6x10^6$	1.9	110	0.08	$1.3x10^4$	1.1
9	$3.8x10^7$	5.3	$7.8x10^6$	2.4	90	0.10	$1.1x10^4$	1.2
11	$5.3x10^7$	6.1	$8.9x10^6$	2.1	80	0.09	$1.6x10^3$	1.4
13	$4.2x10^8$	7.6	$3.1x10^7$	2.7	75	0.06	$1.2x10^3$	0.7
15	$5.4x10^8$	8.3	$4.6x10^7$	2.8	50	0.07	$1.1x10^3$	0.5
17	$8.6x10^8$	7.7	$4.9x10^7$	3.1	43	0.07	$1.0x10^3$	0.5
20	1.2x109	4.3	$5.4x10^7$	4.2	30	0.10	$1.0x10^3$	0.6

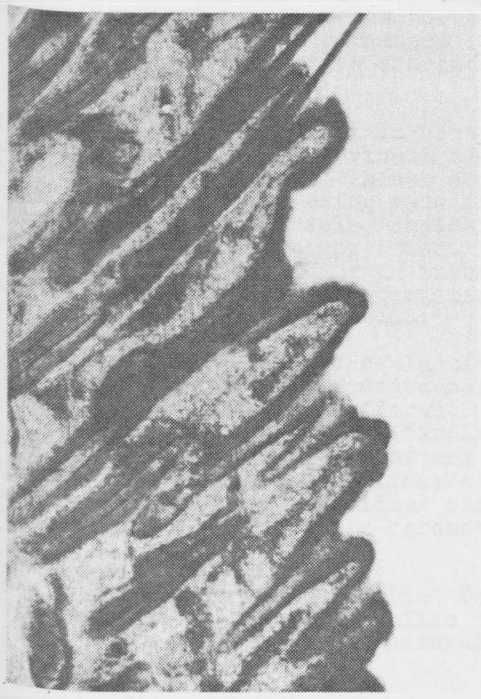

Fig.1.Microstructure of fresh hide derma papillary layer

Fig.2. Microstructure of fresh hide derma reticulum

Fig.3. Microstructure of papillary layer of chilled and stored for 7 days hide derma

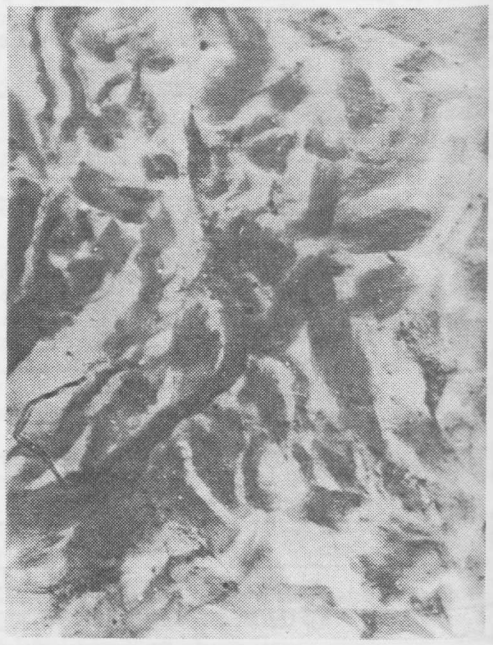

Fig.4. Microstructure of reticulum of chilled and stored for 7 days hide derma