The effect of dry and wet aging of horse meat on color

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Abstract. The color of horse meat may depend on several factors, including storage conditions, animal type and age, as well as meat processing methods. Studies aimed at comparing the color of dry aging and wet aging of horse meat have not been the subject of much scientific research. The purpose of the study is to study the effect of dry and wet aging of horse meat on color. The object of research is a boneless dorsal cut of horse meat. Meat samples were isolated 24 hours after slaughter and stored (2 ± 5 °C) in a dark place. Eight samples of horse meat were cut from a boneless dorsal cut, and then randomly distributed according to the periods and aging method. Two control samples - 1 day, three samples of dry aging – 14, 21, 28 days. Wet aging of horse meat was carried out in vacuum packed form in a refrigerated product storage chamber at a temperature of 2±1 °C and relative humidity of no more than 90% for 28 days. Instrumental color measurements were carried out on the L*, a* and b* scales using a Minolta colorimeter (Minolta CR-400, Osaka, Japan) installed with a D65 illuminator, viewing angle 2°. The differences in the indicator of Lightness L* in meat of dry and wet aging for 14 days were 1,785, at 21 days - 3,784 and 28 days - 10,754, in terms of Redness, a* 11,626 - at 14 days, 13.0841 and 15.1253 were 21 and 28 days, respectively. The difference in Blue, b* was 8.6054, 13.3676, 12.3517 for 14.21 and 28 days. The obtained color differences, ΔE* 17,1346, 21,192, 26,64 indicate that the method of aging of horse meat has a significant effect on its color.

1 Introduction

The color of horse meat may depend on several factors, including storage conditions, the type and age of the animal, as well as meat processing methods [1, 2]. General trends may be as follows:

1 Period of meat aging:

- Short-term aging: It can keep a lighter shade of meat.
- Long-term aging: It can contribute to the formation of a richer color and a cleaner taste. [3]

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2 Type and age of the animal:

- Young animals: They usually have a lighter meat color.
- Older animals: They may have a richer color due to the development of muscles and fats. [4]

3 Conditions of aging:

- Vacuum packaging: It can keep a bright color.
- Open aging: May cause slight changes in color due to exposure of air. [5]

4 Cooking Methods:

- Heat treatment: May affect the coloring of meat.
- Use of spices and marinades: It can also affect the color and taste of meat. [6]

It is important to note that meat color is not always an indicator of its quality or taste characteristics. Color preferences may vary among consumers, and the effect of aging duration should be considered in the context of the preferences of a particular audience. The color of horse meat usually ranges from red to maroon. This shade can vary depending on various factors, such as the age and type of horse, as well as the conditions of its maintenance and nutrition. General characteristics of horse meat color: Young horses: usually have a lighter meat color, bright red color – for foal meat. Adult horses: May have a richer red to maroon color for horse meat. Feeding and housing conditions: The food quality and the conditions in which the horse is kept can affect meat color. Meat processing: Processing methods such as aging and cooking can also affect horse meat color. The color of horse meat is not always a determining factor in its quality or taste characteristics. [7-9]

Studies aimed at comparing the color of dry aging and wet aging of horse meat have not been the subject of much scientific research. Further understanding of the dry and wet aging process effect on meat color is needed.

The purpose of the study is to study the effect of dry and wet aging of horse meat on color.

2 Materials and Methods

The object of research is the boneless dorsal cut of horse meat obtained during the Kazakh butchering of horse meat carcasses — a local breed, a piebald mare, aged 24 months, of the first fatness category, live weight 480 kg, slaughter yield 52%, meat yield 250 kg, in a natural growing system.

The slaughter and primary processing of carcasses was carried out in the afternoon, under the conditions of individual entrepreneur Imenalin, Kostanay region, in accordance with the veterinary and sanitary rules of the Republic of Kazakhstan. Meat samples were isolated 24 hours after slaughter and stored (2±5 °C) in a dark place. Eight samples of horse meat were cut from the boneless dorsal cut, and then randomly distributed according to the periods and method of aging. Two control samples - 1 day, three samples dry aging – 14, 21, 28 days and wet aging were packed in vacuum bags of polyamide type with polyethylene (PA/PE), 120 microns thick, using a Turbovac packaging machine (Turbovac ST-320, Turbovac, Netherlands) - 14, 21, 28 days, respectively.

Wet aging of horse meat was carried out in vacuum packed form in a refrigerated product storage chamber at a temperature of 2±1 °C and relative humidity of no more than 90% for 28 days.

Dry aging of horse meat was carried out in unpacked form, in the dry-aging Samaref dry aging cabinet (SAMAREF DE 700 RF PV BK, Samaref, Italy), at a temperature of 1±2.5 ° C, relative humidity — at the level of 60-75%, for 28 days.

Himalayan salt was used to sterilize the air in the cabinet and absorb excess moisture. Salt also has a positive effect on the taste of matured meat. [11]

The surface color of horse meat was evaluated after each aging period and aging method, also after removing the vacuum packaging of wet aging.

Instrumental color measurements were carried out according to the L*, a* and b* scales using a Minolta colorimeter (Minolta CR-400, Osaka, Japan) installed with a D65 illuminator, viewing angle 2°.

The colorimeter was configured to record and print the average of six readings for each sample. Calibration was carried out before each day and using a completely white sample. Calculations were made based on the equation given in the American Butchers Association Manual for measuring the meat color. [12]

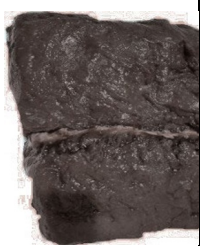
The surface colors of horse meat according to the CIELAB system were compared in accordance with the procedures recommended by Interstate Standard 32226 — 2013 Meat. Cutting horse meat and foal meat into cuts. Technical conditions.

The mathematical processing of the results of studies performed with 3-5-fold repetition, as well as the calculation of correlation dependencies, was carried out using the generally accepted parametric method (Student's t-test) using the Statistica 10.0 program.

3 Results and Discussion

The study obtained the results of visual assessment and instrumental measurement of the horse meat color using a colorimeter, depending on the duration and method of aging. The obtained data are presented in tables 1-3.

Table 1. Surface appearance of horse meat.

Aging method	Duration of aging, day			
	1 Control	14	21	28
Dry				
Wet				

During wet aging, the surface color of horsemeat did not change significantly, it became lighter compared to the control one. This is due to the myoglobin protected from contact with the air of the vacuum packaging of meat. When exposed to air, myoglobin forms the pigment oxymyoglobin, meat becomes darker under the effect of oxygen [13, 14].

The surface color of dry-matured horsemeat changed significantly, from brown to dark brown, due to a lower moisture content and surface drying after aging, which leads to less reflection of light. A 14-day dry aging sample shows a white plaque that appeared under the effect of Himalayan salt.

Based on the results of the assessment of the surface color in the CIELAB system, it was possible to instrumentally determine the correct names of horse meat color and color characteristics.

Table 2. Colors of horse meat surface according to the CIELAB system.

Interstate Standard 32226 — 2013		Aging method			
		Dry		Wet	
Color name	CIELAB	Color	CIELAB	Color name	CIELAB
1 day (Control)					
Red		-	-	-	-
14 days					
Red		Tarpaulin grey		Chestnut brown	
21 days					
Red		Signal black		Mahogany brown	
28 days					
Red		Olive-black		Deep brown	

Table 3. Characteristics of horse meat indicators of the color space according to the CIELAB standard.

Indicators	Duration of aging, day						
	1	14		21		28	
	Aging method						
	Control	Dry	Wet	Dry	Wet	Dry	Wet
Brightness, L	35±1,5	34.187	32.402	17.646	21.430	7.165	17.919
Redness, a	37±2,0	-1.6662	13.2922	-2.0623	15.1464	-3.2654	18.3907
Blue, b	27±1,0	3.3828	11.9882	2.9378	16.3054	4.7296	17.0813
Degree of redness a/b	1.4	0.5	1.11	0.7	0.93	0.7	1.08
Saturation, S	45.804	3.77088	17.9	3.5894	22.255	5.747	25.1
Color tone, N	0.6304	-1.1131	0.7339	-0.959	0.8222	-0.97	0.749
Full color differences, ΔE	-	45.3156	28.181	49.051	27.859	53.78	27.14

Table 3 shows the indicators of horse meat color with different duration and method of aging in the CIELAB system.

As follows from the obtained data, the initial value of lightness L* or color brightness is 34.187 for dry-matured horse meat for 14 days, which indicates a high content of pigments in it. The total concentration of pigments decreased significantly during the 21st and 28th days of aging, 17,646 and 7,165, respectively, which should be attributed to a decrease in the amount of moisture and an increase in the dry matter content. At the same time,

negative values in chromatic coordinates were revealed, primarily the redness value a*. For the feedstock, the redness a* is 37.0 and sharply decreases to a negative value of -1.6662 at 14 days, 21 days -2.623 and reaches a value of -3.2654, it should be associated with a change in the oxidation-reduction state of myoglobin. The dependence of the blue b* color stimulus of horse meat on dry aging duration is a decrease in the aging period of 14 days within 3.3828, compared to the control one. Then there is a decrease to 2,9378 at 21 days, reaching a maximum of 4,7296 for meat with aging period of 28 days. The saturation, S of dry-matured horse meat changed between 14 days 3.77088 and 21 days 3.5894 by 0.2, and at 28 days it increased to 5.747, which made a difference of 1.9. The color tone of the dry-matured horsemeat is more stable, thereby ensuring the color of the meat in the spectrum. Complete color differences, ΔE dry aging of 14, 21 and 28 days, do not affect the actual perception of color by the eye.

According to the wet aging of horse meat in vacuum packaging, the following indicators were obtained. There was a gradual decrease in brightness, L* from 1 day of control to 14 days, 35.0 and 35.40, respectively, followed by a decrease in color brightness of 21.430 and 17.919, at 21, 28 days. There is a change in the redness a *, starting from 14 days - 13.2922, and a subsequent increase in the indicator. The indicator characterizing the blue b* becomes more pronounced on day 14, approaching the value of 11.9882, with a further constant increase. The saturation S of horse meat showed a tendency to increase in values of 17.9, 22.255, 25.1, and the duration of wet aging of 14, 21, and 28 days.

The color tone H* by which a given color is recognized by the human eye and any of the colors visible to humans is identified, showed the stability of the values of various wet aging periods.

The total color differences are within the limits of the human eye susceptibility to differences of the compared samples of less than 3.0 ΔE* and are consistent with the studies [15].

The differences in the indicator of Lightness L* in meat of dry and wet aging for 14 days were 1,785, at 21 days - 3,784 and 28 days - 10,754, in terms of Redness, a* 11,626 at 14 days, 13.0841 and 15.1253 were at 21 and 28 days, respectively. The difference in Blue, b* was 8.6054, 13.3676, 12.3517 for 14.21 and 28 days. The obtained color differences, ΔE* 17,1346, 21,192, 26,64 indicate that the method of horse meat aging has a significant effect on its color.

4 Conclusion

Wet-aged horse meat in vacuum packaging had a more stable color for 28 days, from chestnut brown to deep brown, compared to dry- aged horse meat. Dry aging in the cabinet provided deeper changes in the color of the meat surface from tarpaulin gray to olive black. Wet-aged horse meat was better compared to dry aging in terms of human perception. Wet-aged meat for 14 days, usually had a lighter color than meat aged for 21 and 28 days. But at the same time, the duration of wet meat aging had little effect on the meat color. Dry aging of horse meat has a significant effect on its color characteristics, compared with wet aging meat. It should be noted that when removing the top layer from the dry-matured meat, it has a maroon color.

Acknowledgements

The author would like to thank the chef of the Terra restaurant, F.S. Khukharkin, for using the Samaref dry-aging cupboard. Without the use of theese tools, this research would not have been possible.

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