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Pantohematogen-S as an Ingredient of Specialized Deer Antler Products: Characterization and Authenticity Identification

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ABSTRACT

The objective of the present paper is to provide information about one of the promising antler products, pantohematogen-S. Antler products have been known and used in traditional and modern medicine for a long time as they demonstrate good adaptogenic, nootropic and immunomodulatory properties, enhance stamina and mental health, and boost digestion and metabolism. Pantohematogen is considered highly beneficial for people's health today when researchers are looking for ways to improve the quality of life of contemporary humans as people face water, air, and soil pollution problems and macro and micronutrient deficiency due to an unhealthy diet. The study focused on pantohematogen-S composition and properties, its microbiological indicators, quality and safety criteria, as well as its nutritional and energy values. The paper also deals with the requirements for the process of obtaining blood from the Altai Wapiti females and its storage conditions. The product shelf life is determined following a thorough analysis in the laboratories of the Russian Federation.

Keywords: Pantohematogen-S, Antler product, Food supplement, Properties, Composition.

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INTRODUCTION

The search for new types of local raw materials in the production of specialized foods is one of the priority areas of the state policy of people's healthy nutrition in the Russian Federation.

The term "healthy nutrition" has been in use since the 1990s, and it means that nutrition should both meet the body's needs in nutrients and energy and prevent the development of different multifactorial non-infectious disorders, thus ensuring health maintenance and work capacity. Today the issue of the combined use of food factors and medications while treating common diseases is of great importance [1-3].

In this context, we should also pay attention to specialized products, including biologically active food supplements, which remain reliable, most effective, and most available and affordable to improve people's nutrition and health today [4-14].

Pantohematogen, a product of deer antler, has long been used in traditional and modern medicine and deserves attention as a plant and animal-derived raw material [15-18].

The development of the food group under consideration is innovative if we regard innovation as a final result of a commercial activity aimed at selling a new or improved product in the market or using a new or upgraded

technological process.

MATERIALS AND METHODS

The present paper presents the properties and chemical composition of pantohematogen obtained from Altai Wapiti females' blood, its manufacturing technology, and regulated quality indicators.

Blood sampling was carried out from healthy and veterinary-controlled animals with sterile disposable systems used in blood sampling and transfusion for people.

The animals for blood sampling must meet the requirements of sanitary regulations 3.1.084-96 and veterinary regulations 13.3.4.1100-96. Blood is collected into sterile bottles and must be used in the technological process within two hours after its collection. It can also be cooled and kept in the fridge for up to 48 hours at 0°C or a maximum of 12 hours at 5°C. The tightness of bottles and the storage temperature must be controlled. Blood sampling must be performed for the subsequent veterinary analysis.

The chemical composition of pantohematogen was studied. The research was carried out by the laboratory of phytopharmacology and specialized nutrition. This laboratory operates within the Research Institute of Pharmacology, which is a division of the Tomsk Scientific Center of the Russian Academy of Sciences (the head of the lab is Professor N. I. Suslov, Doctor of Medical Sciences).

Biologically active substances are represented by amino acids, lipid compounds, mainly phospholipids (phosphatidylcholine, phosphatidylethanolamine, cholesterol), and a large number of micronutrients. The main nutrient content is presented **(Table 1).** The table provides averaged data from three measurements of six homogeneous product batches.

The information in the table proves that pantohematogen is a source of several structural and biologically active substances.

Table 1. Chemical composition of pantohematogen

Substance	Content, g/100g	Substance	Content, mg/100 g
Aminoacids		Isolecithin	0.143
Lysine	0.9	Lecithin	0.233
Histidine	0.35	Colaminephalin	0.358
Arginine	1.13	Cerebroside	0.483
4- hydroxyproline	0.95	Cardiolipin	0.555
Triptophan	1.26	**Macro and micronutrients**	
Threonine	0.57	Calcium	0.15
Serine	0.68	Magnesium	74
Glutamine acid	1.6	Aluminum	27
Proline	1.27	Iron	360
Glycine	2.2	Silicon	28
Alanine	1.38	Phosphorus	120
Cystine	0.04	Sodium	900
Valine	0.64	Potassium	120
Methionine	0.1	Copper	0.1
Isoleucine	0.24	Iodine	0.08
Leucine	1.15	Manganese	34
Tyrosine	0.24	Tin	3
Sarkosine	1.16	Barium	6.4
Taurine	0.03	Cobalt	0.05
Lipids		Vanadium	0.04
Free fatty acids	0.56	**Nucleic bases acids**	
Phospholipids	2.42	Guanine	39.9
Triglycerides	0.51	Hypoxanthin	44.2
Sphingomyelin	0.179	Uracil	39.1

Some of them can be considered nutrient substrates, most of them being represented by highly active regulatory molecules (so-called signaling substances). Their intake, even in small amounts, triggers a cascade of metabolic reactions in the body, affecting the enzymes' catalytic activity and recognition of proteins' affinity [6, 7, 16-18]. They also regulate important physiological functions, thus ensuring the pharmacological and functional properties of pantohematogen.

As we can see, pantohematogen either does not contain vitamins or their content is very low, which is why pantohematogen-based specialized products should be enriched with them [3, 4].

Pantohematogen consumer properties include its appearance, taste, dispersity, humidity, authenticity, quantitative content of pantohematogen, proteins, amino acids, carbohydrates, fats, and energy value. Their study and calculation were performed after the pantohematogen manufacturing process finished.

The determining quality criteria, which characterize the product's pharmacological properties and activity, are its authenticity and quantitative content.

These indicators were chosen as markers while determining the product's shelf life and its regulated merchandizing characteristics.

RESULTS AND DISCUSSION

Pantohematogen product was kept in the dark, cool place (a household fridge conditions) for 2.5 years at a temperature of 5.0 ± 1.0 °C. The quantitative hemoglobin content was measured by spectrophotometry every six months. Comparative organoleptic evaluation and microbiological purity testing were carried out both before and after the storage time. Pantohematogen authenticity was determined after the manufacturing process finished.

Six homogeneous product batches were tested three times each.

We can see the dynamic changes of pantohematogen quantitative content during the storage period **(Figure 1)**.

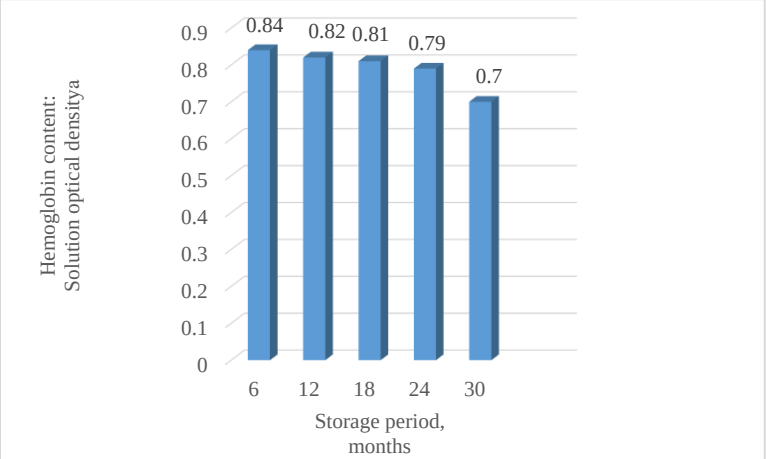

Figure 1. Pantohematogen-S content during the storage period

The data prove that pantohematogen quantitative content did not change much during the storage period and met the regulated level requirements (minimum 0.4). We could only observe its slight decrease after 30 months storage period.

Let us look at the results of the microbiological product testing before and after the supposed storage time **(Table 2)**.

Table 2. Microbiological indicators of pantohematogen-S safety during the storage period (n = 6)

Indicator	Permissible level	Actual content	
		before storage	30 months later
Mesophilic aerobic and facultative anaerobic microorganisms, CFU/g, maximum	$2.5x10^4$	$1.1x10^3$	$1.2x10^3$
Coliform bacteria, per 0.1 g	Prohibited	None	

Sulfite-reducing clostridia, per 1.0 g	Prohibited	None	
Staphylococcus aureus and Proteus, per 1.0 g	Prohibited	None	
Pathogenic microorganisms, including salmonella, per 25.0 g	Prohibited	None	
Yeasts, CFU/g, maximum	200	below 12	below 12
Molds, CFU/g, maximum	200	below 10	below 10

We can state that at the end of 30 months storage period, microbiological safety indicators were the same as at the beginning. This factor as well as the pantohematogen quantitative content indicator, allowed for establishing a guaranteed shelf life of 2 years from the manufacturing date (with a safety factor of 6 months).

Other safety criteria were studied alongside microbiological purity to ensure the product conformance to the requirements of the regulatory documents **(Table 3)**.

Table 3. Pantohematogen-S safety criteria (n = 6)

Indicator		**Permissible level**	**Actual content**
Toxic elements, mg/kg, maximum	Lead	1.0	0.3
	Cadmium	1.0	0.07
	Arsenic	1.5	Maximum 0.2
	Mercury	0.2	Maximum 0.01
Pesticides, mg/kg, maximum	HCH and its isomers	0.1	Maximum 0.006
	DDT and its metabolites	0.1	Maximum 0.02
	Heptachlor	Prohibited	None
	Aldrin	Prohibited	None
Antibiotics, units/g, maximum	Levomycetin	0.01	None
	Tetracycline group	0.01	None
	Grisin	0.5	None
	Bacitracin	0.02	None
	Streptomycin	Prohibited	None
	Penicillin	Prohibited	None
Radionuclides, Bq/kg, maximum	Cesium-137	200	Maximum 27.0
	Strontium-90	100	Maximum 3.0

The data presented in the table indicate the product's sanitary well-being. No changes in organoleptic quality indicators were found.

The product authenticity was measured spectrophotometrically by the hemoglobin absorption spectrum in the range of 480 to 650 nm. We recorded a double flattened peak with the maximum absorption at 540 ± 10 nm, which proves the product's authenticity.

Regulated organoleptic and physicochemical quality properties of pantohematogen-S **(Table 4)**, as well as its nutritional and energy value **(Table 5)**, were determined following the research results.

Table 4. Pantohematogen-S regulated quality criteria

Indicator	**Description**
Appearance	Amorphous powder from reddish-brown to dark brown
Smell	Specific
Taste	Specific with meat flavor
Dispersity	Particles with diameter larger than 0.63 mm – maximum 2%. Particles with diameter larger than 2 mm – not found
Humidity	Maximum 9 %
Authenticity: determined by hemoglobin absorption spectrum of the product solution in 0.5 % ammonium	Double flattened peak with maximum absorption at 540 ± 10 nm and 570 ± 10 nm must be recorded in the range of 480 to 650 nm

solution	
Quantitative content of pantohematogen is measured spectrophotometrically by hemoglobin content	0.1 g of product (accurately weighed) was solved in 0.5 % ammonium solution and brought to 50 cm^3 at 540 nm. The solution optical density measured by a spectrophotometer was minimum 0.4.

Table 5. Pantohematogen –S nutritional and energy value

Indicator	Value
Proteins and amino acids, g/100 g	96.0–97.0 (96.5)
Carbohydrates, g/100 g	0.16–0.18 (0.17)
Fats, g/100 g	0.05–0.07 (0.06)
Energy value, kcal/100 g	385–389 (387)

*Note. Average values of 6 measurements are provided in round brackets.

Pantohematogen-S is a powdery amorphous substance obtained from the fresh blood of female antler deer. Blood is partially defibrinated and dehydrated under mild conditions and is disintegrated at the same time.

Dehydration and disintegration technological processes are carried out in deep vacuum conditions (-1 atm) at gentle temperatures of 36-40 °C. This technology ensures bacteriological purity, high preservation, and functional activity of active substances.

CONCLUSION

The product is a biologically active compound: it has pronounced adaptogenic, nootropic, and immunomodulating effects, demonstrates anti-anemic properties, improves metabolism and digestion, and enhances the physical activity and mental health.

Pantohematogen-S serves as a component for specialized product manufacturing, including biologically active food supplements with different functional properties.

The State Sanitary and Epidemiological Service of the Russian Federation and the Main Testing Center for Food Products at the Research Institute of Nutrition of the Russian Academy of Sciences issued their expert reports on pantohematogen-S. The established shelf life of pantohematogen is 2 years from the date of manufacture. The clinical trial confirms its efficiency and functional properties.

Pantohematogen-S is manufactured at the enterprises of “Yug” company, located in Biysk, which are certified according to the requirements of international standards of the ISO 9001, 22000, and GMP series.

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CONFLICT OF INTEREST: None

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ETHICS STATEMENT: The study was conducted according to the guidelines of the Declaration of Helsinki.

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