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Application of Immunological Control for Prognosis the Productivity of Karakul Sheep

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ABSTRACT: The article provides recommendations on the use of immunological methods and criteria for assessing the level of natural resistance, in order to select animals with high natural resistance. Karakul sheep of the sur (brown) color having a concentration of common immune proteins of serum blood (CIPSB) with a quantitative method of 32–50 mg/ml and a semi–quantitative method of 1.1–2.0 conventional units, cellular immunity according to the skin reaction (delayed hypersensitivity reaction DHR) of 7.0–9.0 mm are classified as highly resistant; with CIPSB 18–31 mg/ml and 0.71–1.0 conv. units, DHR on a skin test of 5–6 mm to medium–resistant and respectively CIPSB of 13–17 mg/ml and 0.4–0.66 conv. units, DHR on a skin test of 3–4 mm and lower to a low–resistant group of animals. The indexes of common immune proteins of serum blood of 8–12 mg/ml and less according to the quantitative method and 0.25–0.45 conv. units according to the indicator method, T–cell activity according to the skin test of 1.0–2.0 mm characterize the immunodeficiency condition.

Studies have shown that the productivity of karakul sheep with a high level of natural resistance was higher than that of low–resistant ones. Karakul lambs with medium and high level of immunological reactivity quickly regained body weight after the stress factors of the weaning period, were better fed and weighed 33.6±0.45 and 34.5±0.35 kg at 8 months of age, the gain during the pasture fattening period was 8.2 ± 0.16 and 8.4± 0.11 kg, respectively, the average daily weight gain 91.1 g and 93.3 g, while animals with low immune reactivity weighed 30.3 ± 0.46 kg, where the gain over the entire period of pasture fattening was 6.7 ± 0.12 kg with an average daily gain of 74.4 g.

Body weight of lambs which suffered immunodeficiency conditions in various colostral–milk periods was 28.1 ± 0.75 kg, weight gain 6.2 kg ± 0.08 kg and average daily weight gain 68.8 g. The meat productivity (slaughter weight) of lambs with medium and high immune reactivity was 2.03 kg and 2.71 kg or 14.03 % and 17.9 % higher than in lambs with low natural resistance, and 3.24 kg and 3.92 kg or 22.4 % and 25.9 % higher compared to lambs which had immunodeficiency syndromes.

KEYWORDS: karakul lambs, natural resistance, immunodiagnostics, immunological indicators and criteria, live weight, live weight gain, slaughter weight, slaughter yield.

INTRODUCTION

Karakul sheep breeding is the leading branch of desert–pasture animal husbandry in Uzbekistan, which produces a variety of livestock products–karakul pelts of various assortment, meat (mutton), lamb meat, sheepskin, coarse wool, rennet.

In order to ensure food security by increasing the production of livestock products, the widespread introduction of modern production methods, as well as the organization of effective use of the achievements of modern information –communication technologies and science in this area, the Decree of the President of the Republic of Uzbekistan No. PD–120 dated on February 8, 2022 “Program for the development of the livestock sector and its branches in the Republic of Uzbekistan on 2022–2026” has been adopted. According to this resolution, in the decision on food security of the Republic, mutton and lamb meat production is assigned one of the leading roles, since the volume of production of sheep and goat meat (in live weight) is planned to increase from 400 thousand tons to 650 thousand tons.

In the karakul sheep industry, changes were made to the technology of keeping young animals to increase production efficiency–the slaughter of lambs (ram–lambs) on the karakul pelts decreased and the number of young animals that left for

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growing up is increased. Economic analysis has shown that leaving karakul lambs of the meat contingent until next year is ineffective, and feeding up to 6–8 months of age in order to produce young sheep's meat is the most cost–effective.

The gene fund of the karakul breed consists of 33 highly productive factory types, including various colors and colorations, 4 karakul pelt, 3 wool–constitutional and 3 ecological types. At the same time, 10 factory types have black, 14 sur (brown), 5 gray, two white and one pink and beige color. These signs are widely used in the evaluation, selection, breeding of karakul sheep and to study of genetic variability [3, 11, 14].

It should be noted that the assessment of the breeding value of animals in karakul sheep breeding is mainly carried out according to zoo technical parameters and phenotypic characteristics – the quality of the karakul pelts at 1–3 days of age, the constitution, wool characteristics, exterior parameters without taking into account natural resistance and other biological and physiological indicators. Long–term unilateral selection only according to the karakul pelt productivity of karakul sheep, without taking into account the level of natural resistance, cannot but affect on the stability of animals and on manifestation of their hereditary productive potential [1, 15].

Previously conducted studies have established that long–term narrowly targeted selection to consolidate economic breeding traits for rare colors and original colorations can also lead to a weakening of resistance, constitutional strength and viability of sheep. Natural resistance is an integral part of the interior of the body, more resistant animals have certain advantages in adaptability, productivity and safety [1, 2, 10].

One of the reasons for the reduction in reproduction of highly productive livestock and the decrease in economic indicators of farms are immunodeficiency of young animals. An increase in immunodeficiency is observed as a result of lowering in pasture yields, an increase in technogenic factors, stress and environmental degradation of the habitat, non–compliance of sanitary and hygienic standards, feeding technology and maintenance of young animals, especially belated colostrums watering or it poor quality, insufficient and inadequate feeding of dams in the second half of pregnancy. All these factors restrain growth and development, lead to a decrease in viability, productivity, as well as an increase in morbidity and animal waste [2, 4, 6, 13].

In this regard, immunobiological monitoring, control of the immune status, early prediction of productivity and diagnosis of immunodeficiency has a great scientific and practical importance for increasing the productivity of animals.

The purpose of the research is study and compare the productivity of karakul sheep which have different levels of immune status.

OBJECTS AND METHODS OF RESEARCH

The research was carried out in the karakul sheep breeding farm "Karnab–Ota" of the Pakhtachi district of the Samarkand region on purebred karakul youngsters of 5–9 months of age of sur (brown) color. Experimental groups of animals were formed according to the principle of analogues, taking into account their karakul pelt type, constitution and the level of natural resistance. Experimental groups of karakul young animals had year–round pasture maintenance and grazed on sagebrush–ephemeral pastures in conditions of gypsum finely crushed desert.

In order to form experimental groups of karakul lambs with different levels of natural resistance, the immune status of animals was determined in the humoral link of immunity by the level of common immune proteins of serum blood (CIPSB) by quantitative (turbo metric) and semi–quantitative (indicator) methods; in the cellular link of immunity by the delayed hypersensitivity reaction (DHR) to the inoculation of diagnostic.

A quantitative (turbometric) method for determining CIPSB was carried out by the reaction of serum turbidity with zinc sulfate by measuring the optical density of the solution using a photo electro colorimeter with usage a red light filter at a wavelength of 500 nm, a cuvette thickness of 10 mm against the control (distilled water with serum). The concentration of CIPSB was determined by the conversion of the photo electro colorimeter reading indexes in mg/ml using the extinction graph and the recalculation table [5].

A semi–quantitative (indication) – field express method for determining CIPSB was carried out by titration 1 ml of the tested of serum blood with a 0.2 % solution of zinc sulfate. Titration was performed with a calibrated pipette with a division price of 0.025 or 0.05 ml pouring drops of the indicator to the serum blood and shaking the test tubes until turbidity appeared. Then the amount of zinc sulfate used in serum titration was calculated by multiplying the number of drops of indicator by 0.05 ml (the price of a drop). The obtained values in ml are not convenient in comparison, since a smaller amount of the consumed indicator

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corresponds to a higher concentration of immune proteins. Therefore, the resulting digital data was transformed into conventional units by (recalculation) dividing 1 ml of the test serum on the amount of the indicator spent on titration. In this recalculation, a high level of immune proteins is characterized by large titers, and a low level is characterized by a smaller titer of the indicator [9].

Cellular immunity was determined by an allergic skin test–for the inoculation of a diagnosis of phytohemagglutinin lectin of glycoprotein origin. The diagnosticum was injected intradermally into the inner part of the fat tail at a dose of 0.1 ml, the reaction was read 4–5 hours after administration according to the thickness of the skin fold and the size of the infiltrate [1]. The mechanism of action of the diagnosticum is such that when it is administered, lymphocytes begin to produce mediators that cause inflammation and thickening of the skin. The higher functional activity and the number of lymphocytes, the higher allergic reaction of the skin characterizes a high level (activity of macrophages and T–lymphocytes) of cellular immunity.

To study productive indexes groups of lambs which have different natural resistance–live weight (kg), dynamics of weight gain (kg) and average daily gains (g), pasture fattening of various resistance groups of animals was carried out, meat productivity was studied according to the results of control slaughter [8].

ANALYSIS OF THE OBTAINED RESULTS

The indexes of natural resistance of karakul sheep according to humoral and cellular factors of immunity, their level, dynamics and variability in accordance with age, color, sex, physiological condition and seasons, accounting for colostral immunity that studied and analyzed from 2001 to 2019 in the laboratory of Immunobiology and Reproduction of Uzbek Research Institute of Karakul Sheep Breeding and Ecology Desert made possible to compile immunological criteria for assessing the natural resistance of karakul sheep.

Below are tables of elaborated immunological indicators and criteria for assessing the immune status in the humoral and cellular immunity for karakul sheep of black and sur (brown) colors.

The given resistance indicators and immunological criteria allow us to divide animals by resistance levels into 4 classes: high, medium, low values, and extremely low resistance indicators, which is characteristic of the immunodeficiency condition.

Table 1 presents immunological criteria for assessing the level of humoral immunity according to the indexes of common immune proteins of serum blood and Table 2 presents immunological indicators for assessing cellular immunity determined by the skin reaction to the apply of phytohemagglutinin (lectin).

Table 1. Parameters of common immune proteins of serum blood for assessing the level of immune status in the humoral link of immunity

Color of sheep	Levels of common immune proteins of serum blood			
	high	medium	low	immunedeficiency
Indicator semi–quantitative method (titration), conv. units*				
Black	1,3–2,9	0,83–1,25	0,6–0,77	0,29–0,50 and <
Sur (brown)	1,1–2,0	0,71–1,0	0,4–0,66	0,22–0,45 and <
Quantitative method (turbo metric), mg/ml				
Black	35,0–51,0	20,0–34,0	14,0–18,0	10,0–13,0 and <
Sur (brown)	32,0–50,0	18,0–31,0	13,0–17,0	8,0–12,0 and <

*conventional units

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Table 2. Parameters of the delayed hypersensitivity reaction for determining the level of immune status in the cellular link of immunity

Color of sheep	The level of T–lymphocyte activity by an allergic skin reaction to the inoculation of immunodiagnosticum			
	high	medium	low	Immune–deficiency
By the thickness of the skin fold, mm				
Black	8,0–10,0	5,0–7,0	3,0–4,0	2,0
Sur (brown)	7,0–9,0	5,0–6,0	3,0–4,0	1,0–2,0
By the size of the skin infiltrate, cm^2				
Black	14–18	10–12	4–6	–
Sur (brown)	12–16	6–10	2–4	–

*square centimeter

As can be seen from Tables 1 and 2, karakul sheep of the sur (brown) color having a concentration of common immune proteins of serum blood (CIPSB) with a quantitative method of 32–50 mg/ml and a semi–quantitative method of 1.1–2.0 conv. units, cellular immunity according to the skin reaction (delayed hypersensitivity reaction DHR) of 7.0–9.0 mm are classified as highly resistant; with a concentration of CIPSB 18–31 mg/ml and 0.71–1.0 conv. units, DHR on a skin test of 5–6 mm to medium–resistant and respectively concentration CIPSB of 13–17 mg/ml and 0.4–0.66 conv. units, DHR on a skin test of 3–4 mm and lower to a low–resistant group of animals.

In addition, studies have found extremely low immunological indicators in karakul sheep, which characterize immunodeficiency conditions. Thus, the indexes of common immune proteins of serum blood of 8–12 mg/ml and less according to the quantitative method and 0.25–0.45 conv. units according to the indicator method, T–cell activity according to the skin test of 1.0 – 2.0 mm characterize the immunodeficiency condition.

According to the conducted studies, with immunodeficiency morphological and functional disorders of cellular and humoral immunity occur in animals at various stages of the development of populations of T– and B–lymphocytes, macro and microphages, the formation of immunoglobulins and components of the complement system. There is a decrease in the functional activity of lymphocytes and phagocytes [2, 16, 18, 19].

Leading in the development of age–related immune deficits in young animals is the deficiency of immunoglobulins Ig A, Ig G, which is one of the important causes of predisposition to recurrent infections of the broncho pulmonary system and gastrointestinal diseases. With a lack of Ig A, the ecosystem of the intestinal microflora is disrupted. The normal intestinal microflora is replaced by large spore –forming rods and anaerobes, coccoid microorganisms.

Thus, the ratio of gram–negative (G–) and gram–positive (G+) microorganisms in the intestinal microflora changes, which leads to intestinal dysfunction, and an increase in toxic microflora leads to toxicosis. Due to intoxication, the walls of capillaries become more permeable, effusions accumulate in the parenchyma of the lungs, catarrhal inflammation develops, blood and lymph circulation in the lungs is disrupted that lead to hypoxia [2, 12, 17].

In this regard, on the background of immunodeficiency, there is a decrease in growth and development, viability, productive indicators, frequent recurrent infections due to banal, conditionally pathogenic microflora is occur, the morbidity and mortality of lambs from enteritis, pneumonia and parasitic diseases increases [7, 20].

Therefore, timely diagnosis of immune deficiency is of great practical importance.

It should be noted that the proposed assessment of immunological reactivity and immunodeficiency of animals can be carried out directly in flocks without the use of special devices, through the use of developed field express tests: semi–quantitative and quantitative tube indicator tests to determine the concentration of common immune proteins and a skin test with diagnosticum phytohemagglutinin to determine the level of cellular immunity.

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Studies have shown that the productivity of karakul sheep with a high level of resistance was higher than that of low–resistant ones. Four experimental groups of lambs were formed to study the relationship between the level of immune status and the effect of immunodeficiency on the subsequent productivity of young animals. The I and II groups of lambs had high and medium immune status indexes when formed at 5 months of age, the III group had a low level, the IV group consisted of lambs that had suffered immunodeficiency conditions during the colostral–lactic period. The selection and formation of groups of animals by resistance levels was carried out by using immunodiagnostic methods and the developed resistance scale described above. (Tables 1 and 2).

Table 3. The results of pasture fattening of karakul lambs depending on the condition of the immune status

Groups of animals taking into account the level of immune status	**n**	**Body weight**		**Weight gain**	
		5 month	**8 month**	**For the entire period**	**per day**
		X±Sx, kg	**X±Sx, kg**	**X±Sx, kg**	**g**
1.High level	25	26,1±0,29	34,5±0,35	8,4±0,11	93,3
2. Medium level	25	*25,4±0,34	**33,6±0,45	8,2±0,16	91,1
3. Low level	25	*23,6±0,37	**30,3±0,46	6,7±0,12	74,4
4. Survivors of immunodeficiency	25	*21,9±0,68	**28,1±0,75	6,2±0,08	68,8

*2–4 td=4,6 P<0,0001; *2–3 td=3,6 P<0,001 ** 2–3 td=5,1 P<0,0001

To study the productivity of different resistance groups of lambs, pasture fattening was carried out after weaning lambs from their mothers on autumn sagebrush–ephemeral pastures. The main vegetation during this period consisted of wormwood (Artemisia diffusa Krash), ephemeroids, kavrak (Ferula assa foetida L.), karak (Cousinia resinosa), salt plants: seta (Salsola scleranta), balik kuz (Climacoptera lanata), donashur (Gamanthus gamocarpus). The yield of pastures where pasture fattening was carried out was determined jointly with the scientific staff of the laboratory of pasture studies by the method of transects and model bushes and averaged 2.5–2.8 c/ha. The nutritional value of pasture feed consumed by lambs averaged 0.64–0.75 feeding units.

Observations of experimental groups of animals continued from 4.5 months to 8 months of age. The results of the investigations showed (Table 3) that sheep with medium and high level of immunological reactivity quickly regained body weight after the stress factors of the weaning period, were better fed and weighed 33.6±0.45 and 34.5±0.35 kg at 8 months of age, the gain during the pasture fattening period was 8.2± 0.16 and 8.4± 0.11 kg, respectively, the average daily weight gain 91.1 g and 93.3 g, while animals with reduced immune reactivity weighed 30.3 ± 0.46 kg, where the gain over the entire period of pasture fattening was 6.7 ± 0.12 kg with an average daily gain of 74.4 g.

As can be seen from the results of studies in lambs which suffered immunodeficiency in various colostral–milk periods, body weight during the pasture fattening period was 28.1±0.75 kg, weight gain 6.2 kg ± 0.08 kg and average daily weight gain 68.8 g.

To study the meat productivity of karakul lambs of various immune status, they were slaughtered. The slaughter was carried out at the slaughter site in compliance with the veterinary and sanitary rules of farm animals, personal hygiene and safety regulations. Experimental groups of 8–month–old lambs stopped feeding 24 hours before slaughter.

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Table 4. Results of control slaughter of lambs

Meat productivity indexes	Groups of animals			
	I	II	III	IV
Pre–slaughter live weight, kg	34,1±0,5	33,3±0,44	29,8±0,71	27,7±0,75
Carcass weight, kg	14,14±0,42	*13,59±0,25	*11,60±0,35	10,60±0,24
Internal fat mass, kg	0,184±0,01	0,175±0,009	0,110±0,01	0,080±0,01
Tail fat mass, kg	0,815±0,01	0,720±0,01	0,640±0,04	0,570±0,08
Slaughter weight, kg	15,14±0,46	**14,46±0,26	**12,43±0,77	11,22±0,33
Slaughter yield, %	44,1	43,5	41,7	40,6

*II–III td=4,4 P<0,05; ** II–III td=4,42 P<0,05
I – lambs with a high level of immune status;
II – lambs with medium level of immune status;
III – lambs with a low level of immune status;
IV – lambs which have suffered immunodeficiency in the colostral–milk period.

The results of the control slaughter (Table 4) lambs show that the slaughter mass of carcasses in medium and highly natural resistant animals averaged 14.46 ± 0.26 kg and 15.14 ± 0.46 kg, with a slaughter yield of 43.5% and 44.1%, and in lambs with a low level of natural resistance and that had immunodeficiency, respectively, 12.43 ± 0.77 kg and 11.22 ± 0.77 kg, with a slaughter yield of the output is 41.7% and 40.6%. The meat productivity (slaughter weight) of lambs with medium and high immunoreactivity was 2.03 kg and 2.71 kg or 14.03 % and 17.9 % higher than in lambs with low natural resistance, and 3.24 kg and 3.92 kg or 22.4 % and 25.9 % higher compared to lambs which had immunodeficiency syndromes.

Thus, a low level of immune status and immunodeficiency lead to a decrease in the development and productivity of young animals. As can be seen from the results of studies in lambs who suffered immunodeficiency in the colostral–milk period, body weight during the pasture fattening period from 5 to 8 months of age was less by 5.5 kg and 6.4 kg, and weight gain by 2 kg and 2.2 kg compared with lambs who had medium and high level of immune status. The slaughter weight of lambs that had immunodeficiency was 11.22 kg, with a slaughter yield of 40.6%, which is 3.24 kg and 3.92 kg lower compared to lambs with medium and high levels of immunological reactivity.

CONCLUSION

1. The elaborated immunobiological indicators and criteria can be used in conducting a comprehensive assessment to monitoring the immunobiological status of karakul sheep. This will allow selecting highly resistant and viable individuals with increased productive potential;
2. Taking into account immunobiological indexes, monitoring the level of natural resistance and early diagnosis of immunodeficiency can reduce economic losses from decrease of productivity;
3. The proposed methods of immunodiagnostics and immunological criteria facilitate to the creation of highly resistant and highly productive flocks of karakul sheep.

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