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Monitoring the development of young camels and wool quality camels of Kazakhstan population

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Abstract. The purpose of the study is to explore economically valuable signs of female camels and set the selection criteria for down hair fibers according to length and fineness. The shorn wool amount was determined during spring shearing by individual weighing of wool with 0.1 kg precision balance. Selection criteria for down hair in Arvana breed are elaborated, with the parameters of length min. 9 cm and fineness of 15-19 microns, and for Kazakh Bactrian breed – with the parameters of length min. 12 cm and fineness of 14-18 microns; these criteria were used to select and form preferable types of 54 and 224 animal units correspondingly for further selection process works to increase wool production in stocks. For Bactrian camels, these parameters are 11.0% lower in Kospak-1 camels, 12.2% lower in Kospak-2 camels and 4.8% lower in Kospak-3 camels. As for the length of down hair fibers, it is almost the same for all the studied young camels. The absolute gain of the body weight of colts of domestic breeds is relatively high, making 103.8-127.4 kg, with the relative gain of 329.5-397.8 kg and with the average daily gain – 576.7-707.8 g.

1. Introduction

Camel is a future hope as it is playing an important role in the national economy and food security for some countries in the world. Camel is a best hope for dry areas and arid environments [1]. It has nourished the bedouins, nomads and pastoral people since centuries. It is a source of food, fiber, riding, draft power and recreation. It is a potential source for future food production especially for pastoralists and people in arid lands. Camel can utilize poor quality forages with much more efficiency, as it retains fiber in its fore stomach for long as 70 hours [2]. Camel can survive and produce in severe, hot and hostile environments with equally good potential as other domestic animals in favorable environment [3].

Camel breeding in the Republic of Kazakhstan is primarily developed to produce meat and wool. Camel wool has a strategic importance for textile. However, there are gaps concerning the selection of camels according to several parameters of wool production [4].

The diverse functional role of the camel coat and its value attach significance to the studies of wool production.

Both dromedary and Bactrian camels are associated with immense economic value in desert areas where they have been used for transportation and trade as well as a source of products such as meat,



milk and wool. Bactrian camels are represented by the wild (*Camelus ferus*) and domestic (*Camelus bactrianus*) species. At present, wild Bactrian camels are the only wild survivors of the Old World camels and inhabit northwestern China and southwestern Mongolia, especially the Outer Altai Gobi Desert. Domestic Bactrian camels are mainly distributed in the desert steppes of Central Asian Countries, such as China, Mongolia, Russia, Kazakhstan, and Iran. Moreover, different living environments, breeding control and food sources have led to the development of domestic Bactrian camels into many unique populations, each with local and morphological characteristics. However, with the continuous development of modern transportation, improvements in agricultural mechanization and the development of camel products, the number of camel herds has declined rapidly, resulting in the depletion of genetic resources. Therefore, revealing the genetic diversity and the origin of different Bactrian camel populations are greatly necessary for the protection and exploitation of camel genetic resources [5].

Wool coat plays a significant role for a camel as it is one of its thermoregulation mechanisms. Through the coat, the camel's body is in constant connection with the environment. The coat protects the camel's body from cold in winter and from overheating in summer.

The wool coat protects the animal's body from the impact of thermal factors of the environment (temperature, humidity, air movement, solar radiation) and it has direct importance for the development of animals and their reaction to heat and cold.

Camel wool is an economically valuable type of camel productivity. It is used to make blankets and knitted wear [6].

As an important class of specialty natural fiber, camel hair has distinctive characteristics, such as luster, softness, warmth, and natural colour. Owing to its exceptional temperature-regulating properties, camel hair is an ideal material for apparel applications. Therefore, the demand for such rare animal fibers may increase as their use in some consumer items, such as high-grade fabrics, makes them more attractive. Despite its small quantitative contribution, the significance of camel hair in the apparel and textile industry should not be underestimated. Camel hair is normally found in various shades of brown or gray; however, high levels of whiteness are essential for apparel fibers [7].

Today, healing properties of camel wool are widely used in medicine to make medical belts [8].

In camel breeding, many issues concerning camels' biology are still unexplored [9].

Taking into account the great importance of the condition and development of the wool coat in the thermal adaptation process of camels and the increase in wool shearing, ecological and physiological studies of the Kazakhstan population of camels should be continued to identify positive response ensuring advance in their wool productivity.

Mineral estimation in camel hair is comparatively a newer concept in Pakistan. The study of mineral profile gives fruitful information about the general health status of the animal so could be used as an indirect tool for evaluation of nutritional status and well-being of an animal. Camel hair accumulates all important minerals and is commonly available tissue which can easily be collected, stored, transported and if needed can easily be resampled.

Internal metabolic environment like blood, lymph and extra cellular fluids plays role in the development of camel hairs, as all the constituents enters into body accumulates in hairs and reflect exposure record of nutritional and toxic metals intake. The mineral status of camel hair can efficiently be used as tool indicator of mineral deficiency in soil. Also the level of these minerals could be used in the diagnosis of various diseases, metabolic disorders and nutritional status of the camel calves [10].

The purpose of the study is to explore economically valuable signs of female camels and set the selection criteria for down hair fibers according to length and fineness.

Based on the studies, it was found that for parental couples with a coefficient of wool clip up to 0.8 at the age of one year, the amount of wool clip was 2.4 kg, which is significantly lower by 12.5% compared to herd mates from parents with a coefficient of wool clip of 0.9-1.4, and 29.2% lower in comparison with young one-year-olds obtained from parental couples with the coefficient of wool clip of 1.5 and above. It was established that the real wool cut was lower in two-year-old females obtained from parents with a coefficient of wool clip of up to 0.8 and 1.5 and higher. In

two-year-old females obtained from parental couples with the coefficient of the wool clip of 0.9-1.4, the real wool cut was 9.1% higher than predicted. In the future, during the selection, it is recommended to give preference to individuals with a coefficient of shear of wool 0.9-1.4 [11].

Camels of the main herd on average produce wool from 5.1 kg to 5.6. The average daily milk yield in the third month of lactation was 5.7-5.9 kg. It has been established that for parental couples with a coefficient of hair cut up to 0.8 camels at the age of one year have a hair cut of 2.4 kg, which is significantly lower by 12.5% compared to peers received from parents with a coefficient of hair cut of 0.9-1.4, and 29.2% lower – in comparison with young one-year-olds received from parental couples with a coefficient of hair cut of 1.5 and above [12].

2. Materials and methods

The growth intensity of colts under the age of 6 months is determined with the standard methods. The shorn wool amount was determined during spring shearing by individual weighing of wool with 0.1 kg precision balance.

The ratio of down hair fibers to the general fiber content was determined per 1 cm² of wool shorn from the side breast part. The wool length was determined with a metal ruler of 1 mm precision; the wool fineness was determined with a preparation using a lakameter (Nicetymeter, 2017, China,) according to the VIZH (All-Russia Research Institute for Animal Husbandry) method.

The milk productivity of a milking herd in standard farms was studied by performing the reference milk yield with Laktan-3 (SibAgroPribor, 2017, Russia,) analyzer every month considering production, fat content and protein content in milk [13]. The morphofunctional peculiarities of female camel udders were determined under the method of A Baimukanov [14].

The cup-shaped udder has dugs of 4.0-6.0 cm long, at the base of the conical shape and widely spaced, directed downward. The round shape udder has dugs 2.0-6.0 cm long, at the base of the conical and pear-shaped, medium spaced, directed downward. Flat udder is with dugs 2.0-4.0 cm long, pear-shaped at the base, widely spaced, directed to the sides. Lobular udder has nipples 6.0 cm long and more, at the base of the pyramidal shape, widely spaced, directed to the sides. The udder lobes stand out clearly from the base to the dugs. The primitive shape of the udder has nipples up to 2.0 cm long, at the base of a pear-shaped shape, approximate, directed to the sides.

Total protein content in milk was determined with AM-2 milk analyzer (SibAgroPribor, 2017, Russia). The fat content in milk was determined with Master ECO Milkotester device (Milkotester, 2017, Bulgaria).

The process parameters of female camel selection according to their milk production was determined according to the degree of lactation full value and of the impact on milk yield and fat content in milk. The gradation of female camels according to the degree of lactation full value was made into three ranks: up to 65-74; 75-84; 85 and above. The degree of lactation full value in female camels was determined with the formula (1):

$$DLFV = \frac{AY \cdot 100}{ADY \cdot n}, \quad (1)$$

where DLFV – degree of lactation full value; AY – actual yield for the whole period of lactation; ADY – average daily yield in the third month of lactation; n – number of lactation days.

The milking capacity coefficient was determined by the ratio of the actual yield for the active lactation period to the body weight (2):

$$MCC = \frac{MY}{BW}, \quad (2)$$

where MCC – milking capacity coefficient, MY – milk yield for a lactation, BW – body weight.

The gradation according to the milking capacity coefficient was made into three ranks: up to 1.4; 1.5-1.9; 2.0 and above.

The impact of fertility index on the actual milk yield in trial Bactrian female camels of the South Kazakhstan type was determined with the formula, suggested by Professor A Baimukanov (3):

$$F = 365(n-1) \frac{100}{N}, \quad (3)$$

where F – fertility index, n – number of coltings, N – number of days between the first and the last colting.

The gradation according to the fertility index was made into three ranks: up to 42; 42 - 47; 47 and over.

The impact of shorn wool amount coefficient (SWAC) on the intensity of reaching the best finish and on the body weight was determined in the growing stock of male camels born in 2017, while the shorn wool amount coefficient is calculated with the formula: (4).

$$SWAC = \frac{WAC}{BW} \cdot 100, \quad (4)$$

where SWAC – shorn wool amount coefficient, WAC – shorn wool amount, BW – body weight.

The gradation according to the shorn wool amount coefficient was made into three ranks: up to 0.8; 0.9-1.4; 1.5 and over.

Biometric processing was carried out according to the method of D Baimukanov and others [12].

3. Results and discussion

At birth, Arvana colts had the body weight of about 28.2-32.1 kg; Kazakh Bactrian colts of the same age – 30.1-32.1 kg. At the age of 6 months, the dominance trend in the body weight of Kazakh Bactrian colts over Arvana colts of the same age is preserved, reaching the level of 148.5-160.2 kg. Among Kazakh Bactrian colts, both at birth and at the age of 6 months, species of Pre-Caspian camel breeding zone have the highest body weight, and those of Pre-Balkhash zone have the lowest body weight, which is a peculiarity of the western camel population. In general, Arvana animals of various zones do not have significant differences in body weight, which is a proximal ecologic-genetic trait of their breeding.

The dynamics of body weight was determined by absolute, average daily and relative gains. The absolute gain of the body weight of colts of domestic varieties is relatively high, making 103.8-127.4 kg, with the relative gain of 329.5-397.8 kg and with the average daily gain – 576.7-707.8 g. These parameters are higher in Kazakh Bactrian colts as compared with Arvana colts of the same age.

When studying the peculiarities of qualitative composition of Arvana and Kazakh Bactrian camel wool, it was found out that the longest fibers are in the neck area. By the length of wool fibers, Kazakh Bactrian camels are reliably higher than Arvana dromedaries. In Arvana breed, the fiber length was 15.3±1.5 cm in adult male camels, 12.5±0.8 cm in female camels, 10.4±0.09 cm in replacement female camels and 9.5±1.1 cm in young camels. Wool fibers in the neck area are of special interest for textile industry when making felts. In Kazakh Bactrian camels, the fiber length in the neck area was 55.3±2.1 cm in adult male camels, 40.7±4.2 cm in female camels, 9.5±1.1 cm in replacement female camels and 15.4±1.3 cm in young camels.

The shortest wool fibers are in the back area, in the rump area and in the stomach area; the length of wool fibers is identical. The coarsest fibers are in the neck area. The wool fiber fineness in the neck area in Arvana camels varies from 21.3±1.5 to 30.5±3.1 microns, in Kazakh Bactrian camels – from 20.6±1.8 to 35.3±4.6 microns. We recommend using captured data as selection criteria for Arvana and Kazakh Bactrian camels in qualitative wool parameters.

It was established that the specific weight of down hair fibers varies from 71.55±5.41 to 77.4±3.97 %, whereas fineness is 14.0 to 16.5 microns, down hair length is 11.72±0.4 – 12.41±0.47 cm. In textile industry, down hair fibers are in the most demand. Therefore, when selecting Kazakh Bactrian camels, we recommend taking the minimum parameters – 71.55%; for female camels – the

average parameters of 74.85 %, and for stud camels 77.4 %.

The selection criteria for down hair fibers in Kazakh Bactrian camels must be the minimum length of 12 cm and fineness of 14-18 microns. The specific gravity of junction hair was from 11.35 ± 0.08 to 14.15 ± 0.20 %, the fineness varied from 23.31 ± 0.17 to 38.51 ± 0.27 microns, the length varied from 18.51 to 21.18 cm. The specific gravity of guard fibers was at the level of the specific weight of junction hair, which is 11.4-14.3%, the fineness varied from 80.5 ± 1.5 microns to 86.1 ± 1.8 microns. Guard fibers had the length from 30.7 ± 0.9 cm to 36.1 ± 1.3 cm.

The specific gravity of down hair fibers in Arvana camels was from 68.5 ± 3.4 to 71.2 ± 3.6 %, the fineness of down hair fibers was from 17.1 ± 0.2 to 18.4 ± 0.9 microns, and the length of down hair fibers was from 7.9 ± 0.4 to 9.4 ± 0.5 microns (table 1).

Table 1. Characteristics of physical parameters of wool fibers in Arvana camels.

Parameter	Ecological zone			
	Arys-Turkestan			Pre-Aral
	Sydzybekov A. Collective Farm	Usenov N Collective Farm	Gulmayra Collective Farm	Korgan NB Collective Farm
<i>Down hair fibers (from 1 micron to 21 microns)</i>				
Specific weight,	68.5 ± 3.4	69.1 ± 3.2	70.8 ± 2.9	68.9 ± 2.6
% range	59.1-80.3	62.4-79.9	64.1-84.1	58.0-77.4
Fineness, microns	17.4 ± 0.3	17.8 ± 0.5	18.1 ± 0.4	18.4 ± 0.9
range	7.0-21.0	6.0-20.0	6.8-20.1	6.3-19.0
Length, cm	9.8 ± 0.4	7.9 ± 0.4	9.4 ± 0.6	8.3 ± 0.3
range	4.1-12.5	5.4-11.7	5.1-12.2	4.8-11.9
<i>Junction hair fibers (from 21 microns to 51 microns)</i>				
Specific weight,	15.8 ± 0.3	15.7 ± 0.7	13.8 ± 0.3	15.6 ± 0.6
% range	8.4-19.6	8.8-21.4	7.3-18.9	9.5-22.3
Fineness, microns	33.1 ± 1.4	38.5 ± 1.9	37.4 ± 2.9	41.1 ± 2.5
range	22.4-50.5	25.8-48.5	24.7-49.8	29.1-50.9
Length, cm	12.1 ± 0.5	9.8 ± 0.7	11.1 ± 0.8	12.7 ± 0.8
range	5.0-16.5	6.0-11.7	5.5-15.5	5.9-17.3
<i>Guard hair fibers (from 51 microns to 100 microns)</i>				
Specific weight,	15.7 ± 0.4	15.2 ± 0.4	15.4 ± 0.4	15.5 ± 0.4
% range	9.6-22.5	9.8-25.1	8.6-20.7	9.6-22.5
Fineness, microns	87.1 ± 3.1	79.1 ± 2.8	83.7 ± 3.9	94.1 ± 4.5
range	51.0-98.0	51.0-98.5	51.0-97.2	51.0-99.6
Length, cm	16.1 ± 0.5	18.4 ± 0.2	17.1 ± 0.2	15.9 ± 0.6
range	10.0-22.0	10.0-24.0	10.0-25.0	10.0-20.0

The selection criteria for down hair fibers in Arvana camels must be the minimal length of 9 cm and fineness of 15-19 microns. The specific gravity of junction hair was from 13.8 ± 0.3 to 15.8 ± 0.3 %, the specific gravity of guard hair was from 14.7 ± 0.4 to 15.7 ± 0.4 %. As for fineness, guard hair is reliably thicker compared with junction fibers of wool coat. The obtained data can be further used in specification of Arvana camel wool.

Based on the elaborated selection criteria for down hair fibers in Arvana camels, with the parameters of minimum length of 9 cm and fineness of 15-19 microns, for Arvana breed of 125 camels, 54 animals were selected and formed, or 42.4% of preferable type for further selection processing works to increase wool production in animal stocks (table 2).

Table 2. Formation of preferable types in the quality of wool production based on the selection criteria for down hair fibers in length and fineness in various areas of South-West region.

Camel breeding zone	Base collective farms	n	Selected preferable types animal units	
				%
Arys-Turkestan	Sydzybekov A.	30	13	43.3
	Usenov N.	50	22	44.0
	Gulmayra	25	10	40.0
Pre-Aral	Korgan NB	20	9	45.0
	Total Arvana	125	54	42.4
	Kuladinskiy LLC	75	56	74.7
Pre-Caspian	Zhana-Tan LLC	27	19	70.4
	Pervomayskoe LLC	40	29	72.5
Karatau-Muyunkum	Bagdat	30	22	73.3
	Karakur Agricultural Production Cooperative	35	26	74.3
Mangystau	Tauchyk LLC	70	48	68.6
Pre-Balkhash	Kazbek-Bek LLC	32	24	75.0
	Total Bactrian	309	224	72.5
Total		434	278	64.1

Considering a large importance of the condition and development of wool coat in the thermal adaptation process of camels and in the increase of shorn wool amount, we continued ecological and physiological studies of Kospak camels to detect positive reactions providing the increase of their wool productions.

Our studies showed that according to the content of its fibers, camel wool relates to the group of non-homogenous wool, mixed of down hair, guard hair and junction hair.

According to the classification of morphological types of wool fibers [1], down hair includes thin curved fibers without cores with the diameter max. 30 microns; junction hair includes wool fibers of 30 to 52 microns fineness with non-homogeneous core layer or without it; guard hair is rough weak almost straight fibers with even core channel. The guard hair thickness varies from 52 to 75 and over 100 microns.

In our research, down hair fibers are over 1.5 times thinner than in Kospak-1 young camels – the down hair thickness was 19 ± 0.1 microns, in Kospak-2 young camels – 19.3 ± 0.2 microns, in Kospak-3 young camels – 21.1 ± 0.2 microns. Bactrian camels have slightly thinner down hair, equaling 16.0 ± 0.1 microns.

The down hair content in wool coat and its specific gravity has a positive impact on wool quality; for a camel's body, down hair protects the body from cold. The wool coat in Kospak-1 camel contains $81.0 \pm 0.3\%$ of down hair, in Kospak-2 – $79.8 \pm 0.3\%$ of down hair, in Kospak-3 – $87.2 \pm 0.4\%$ of all the number of woolen thread in the hair lock. In the comparative aspect with Kazakh Bactrian breed, these parameters are 11.0% lower in Kospak-1 camels, 12.2% lower in Kospak-2 camels and in 4.8% lower in Kospak-3 camels. As for the length of down hair fibers, it is almost the same for all the studied young camels (7.0 cm in Bactrian camels, 6.9 cm in Kospak-1, and 6.8 cm in Kospak-2 and 8.2 cm in Kospak-3 camels).

As for the content of junction and guard hair in wool coat of the studied young camels, there are no big differences between Kospak groups and Bactrian camels; there are also no big differences between the fineness and length of these fibers. The fineness of junction hair in Bactrian camels is 33.0 microns, in Kospak camels – 32.8-33.5 microns; the length is 8.7 cm and 8.3-8.5 cm respectively.

Regarding the fineness and length of guard hair, we noticed difference depending on the area of their growth. In young camels of all the studied groups, junction hair in the fleece wool is significantly thinner than hair in the neck area (58.5 microns vs. 74 microns; for the length: 10.5 cm vs. 25-30 cm).

The core layer in guard hair is a porous substance, filled with inert air, without convection current (dark solid funis under the microscope); it performs a significant function in thermal isolation of wool coat. Maximal air tranquility in the camel's wool coat is necessary for better thermal isolation of the body. Fibers with strongly developed core have the best thermal isolation qualities.

The result of studying age-dependent dynamics of shorn wool amount of trial young camels are shown in table 3.

Pure-breed Kazakh Bactrian camels at the age of 1 year have wool production of 3.15 ± 0.16 kg and surpass the hybrid Kospak camels of the same age ($P < 0.01$). Kospak-1 camels at the age of 1 year have wool production of 1.71 kg, Kospak-2 – 2.31 kg, Kospak-3 – 2.59 kg. For hybrid Kospak camels it was established that with the increase of pedigree of Bactrian camels, wool production reliably increases ($P < 0.05$).

Table 3. Age-dependent dynamics of shorn wool amount of young camels, kg.

Group of young camels	Age, n=10, $\sum n=40$					
	1 year		2 years		3 years	
	M \pm m	C _v	M \pm m	C _v	M \pm m	%C _v
Kazakh Bactrian	3.15 \pm 0.16	15.9	4.25 \pm 0.17	12.4	4.95 \pm 0.6	12.9
Kospak-1	1.71 \pm 0.09	17.0	2.24 \pm 0.1	11.4	2.68 \pm 0.17	8.9
Kospak-2	2.31 \pm 0.07	8.7	2.72 \pm 0.06	7.7	3.22 \pm 0.18	7.7
Kospak-3	2.59 \pm 0.09	11.4	3.14 \pm 0.1	9.6	4.09 \pm 0.17	13.3

n – number of animals, M \pm m – arithmetic mean and arithmetic mean error, C_v – coefficient of variation

At the age of two, wool production in Bactrian camels was 4.25 kg at C_v=12.4%, in Kospak-1 – 2.24 kg at C_v=11.4%, in Kospak-2 – 2.72 kg at C_v=7.7% and Kospak-3 – 3.14 kg at C_v=9.6%.

At the age of three, wool productivity in Bactrian camels was 4.96 \pm 0.20 kg, in Kospak-1 – 2.68 \pm 0.07 kg, in Kospak-2 – 3.22 \pm 0.08 kg and Kospak-3 – 4.09 \pm 0.17 kg. Wool production reliably increases in all young camels irrelevant of their origin in the age-dependent aspect ($P < 0.01$). Shorn wool amount variability in young camels shows the possibility of target selection into the selection stock according to wool production. This will further allow getting a homogeneous camel stock under wool production, which has big importance in the improvement of primary processing technology of camel wool.

An amount of shearing reliably increases with the camel's age: in Bactrian camels, it is 25.9% increase at the age of two, 14.4% increase at the age of three; in Kospak-1 camels, it is 22.3% increase; in Kospak-2 camels – 15.1% increase and in Kospak-3 camels it was 17.5% increase of wool production at the age of 2 years; at the age of 3 years, the increase of shearing in Kospak-1 camels was 16.4%, in Kospak-2 – 15.5% and Kospak-3 – 23.2%, compared with the previous year.

In the comparative aspect of shearing of pure-bred Bactrian camels and hybrid young camels, at the age of one year, Bactrian camels had wool production 45.7% higher than in Kospak-1 camels, 26.7% higher than in Kospak-2 camels and 17.8% higher than in Kospak-3 camels. At the age of two, this difference became even bigger, making 47.3% higher than in Kospak-1 camels, 36% higher than in Kospak-2 camels and 26.1% higher than in Kospak-3 camels. At the age of three, Bactrian camels had wool production 45.8% higher than Kospak-1 camels, 34.9% higher than Kospak-2 camels and 13.4% higher than Kospak-3 camels. Adult Bactrian camels (over 5 years of age) had wool production 32.3% higher than Kospak-1, 33.8% higher than Kospak-2 and 17.6% higher than Kospak-3.

The detected trend in wool production is general for Kospak hybrid camels. The causation of it is in their origin (the presence of dromedary pedigree).

According to the GOST USSR 5108-67 [15], camel wool is divided into four classes according to their quality: Class One includes fleece wool, mainly consisting of down hair and junction hair with an

insignificant amount of guard hair. Class Two includes coarser wool, than Class One wool: it has less down hair, but coarser junction hair. Class Three includes wool, mainly consisting of long junction hair and insignificant amount of down hair. Class Four includes wool, felted of separate felt-like locks.

Data on wool content of the studied Kospak camels according to the class is presented in table 4.

Table 4. Parameters of wool classes in Kospak camels, %.

Wool class	Groups of young camels		
	Kospak-1	Kospak-2	Kospak-3
One	80.4	87.7	76.8
Two	19.0	10.0	2.0
Three	0.6	2.2	3.0
Four	-	0.1	0.2

The highest output of Class One wool is shown for Kospak-2 – 87.7%, as compared with Kospak-1 (80.4%) and Kospak-3 (76.8%). The output of Class Two wool is higher in Kospak-1 (19.0%) compared with Kospak-2 (10.0%) and Kospak-3 (2.0%).

The highest output of Class Three wool is for Kospak-3 (3.0%) compared with Kospak-2 (2.2%) and Kospak-1 (0.6%). The highest output of Class Four wool is for trial hybrid camels and makes 0.1% in Kospak-2 and 0.2% in Kospak-3.

The obtained data on wool production of hybrid camels may be used as the standard for target selection and breeding to create the stock of combined productivity direction.

Depending on impurity, the average of 90.5% of shorn wool weight of Kospak group relates to normal wool, and only 9.5% relates to contaminated wool, containing vegetable matter.

In whole, the quality and quantity of hybrid camel wool of Kospak group will further allow using target selection, breeding, and creating stock in the Southern Kazakhstan of high-performance camels of combined and wool and dairy directions of productivity.

Trial young camels evidently has body type and exterior typical for the original parent forms (table 5).

Table 5. Growth and development of young camels in the post-weaning period depending on process parameters of selected parameters of the female camels (n=5).

Productivity directions	Age	Body weight, kg	Height between humps, cm
Milk	At birth	40.3±1.9	109.7±2.1
	3 months	114.0±4.4	130.3±3.8
	6 months	169.9±6.3	145.1±3.3
	9 months	190.2±4.2	148.9±1.5
	12 months	232.7±5.7	155.4±1.1
	15 months	272.5±6.4	159.2±1.3
Wool- and meat	At birth	34.2±1.5	104.0±2.4
	3 months	94.6±3.7	123.4±3.1
	6 months	144.5±5.1	137.2±3.5
	9 months	193.6 ±3.5	145.6±2.2
	12 months	240.1 ±4.7	151.1±2.7
	15 months	289.6 ±5.3	156.3±1.9
Milk- and meat	At birth	36.8±1.9	107.1±1.8
	3 months	108.9±2.8	128.6±2.1
	6 months	156.2±6.1	141.9±2.5
	9 months	192.6±4.9	146.3±2.9
	12 months	242.4±5.2	152.8±2.7
	15 months	282.7±3.6	158.2±2.3

In particular, young Kazakh Bactrian camels are characterized with stockiness and high blockiness at birth. Young Kazakh Bactrian camels of milk productivity direction have the body weight of 40.3 kg at birth, camels of wool and meat direction – 34.2 kg and of milk and meat direction – 36.8 kg.

Young Kazakh Bactrian camels of South Kazakhstan type, born by female camels, corresponding to the milk productivity direction surpassed female camels of wool and meat direction of the same age by 17.8% ($P<0.01$) in body weight, of milk and meat direction in ($P<0.1$).

In the first three months of postembryonic development, the body weight of Kazakh Bactrian camels from females of milk productivity direction increased in 2.8 times, of wool and meat direction – in 2.76 times, of milk and meat direction – in 2.95 times.

When reaching the age of six months, colts born from milk female camels surpassed mates of wool and meat productivity direction of the same age by 25.4 kg, of milk and meat camels by 13.7 kg. It means that high milk yield of female camels has an evident positive impact on the growth and development intensity of young camels in the pre-weaning period.

After weaning, the intensity of growth and development significantly decreases, which impacted the increase of the absolute body weight from the age of 6 to 9 months. After weaning, in young camels from milk female camels, the body weight increased by 11.9%, from wool and meat female camels – by 34.0%, from milk and meat female camels – by 23.3%. It implies that early weaning is not profitable for young camels of milk-breeding female camels.

In Kazakh Bactrian young camels of milk productivity direction, in further 90 days (from the age of 9 to 12 months), the increase in body weight was 42.5 kg, in camels of wool and meat direction – 46.5 kg, of milk and meat productivity direction – 49.8 kg.

From the age of one year to 15 months, the body weight of young camels of milk productivity direction increased by 17.1%, in wool and meat camels – by 19.1%, in milk and meat camels – by 16.6%.

In 2018-2020, we studied the impact of process parameters of female camels on the intensity of growth and development of young camels after weaning. The weaning was made in the age of 9 months (table 6).

When studying female camels of the basic stock with process parameters according to the degree of lactation full value (DLFV) it was established, that with the lactation full value of 75-84%, camels in the period from 9 months of age to one year of age have an intensely growing height at the shoulders (8.8 cm) compared with camels of the same age, born from female camels with DLFV 65-74% (5.7 cm) and 85% and higher (8.5 cm). Similarly, the body weight also increases in young camels with DLFV 75-84% (37.6 kg), 65-74% (39.4 kg), 85% and higher (41.1 kg) (table 6).

In the following three months, the increase of body weight of young camels from female camels with DLFV 65-74% was 37.4 kg (16.2%), with DLFV of 75-84% – 16.2 kg (6.8%), and 24.2 kg (10.3%) from female camels of DLFV - 85% and higher. When reaching the age of 15 months, the shoulder height in all the young camels was the same, 154.6-155.8 cm. The obtained data did not allow to establish the efficiency of DLFV on the intensity of growth and development of young camels in the post-weaning period.

It was found that in female camels with milking capacity coefficient (MCC) up to 1.4; 5-1.9 and 2.0 and higher, the body weight of young camels in the post-weaning period increases from the 9 months of age to one year of age by 32.9%-19.9%-21.8%, at the age of 12 to 15 months – by 14.1%-15.5%-12.45%. It means that in the first three months, young camels from females with MCC up to 1.4 intensely grow the most, and in the further three months – young camels with MCC 1.5-1.9.

As for the shoulder height, the increase in young camels from 9 to 12 months of age was 6.5 cm-6.4 cm-7.9 cm; from 12 to 15 months of age – 6.6 cm-6.7 cm-4.2 cm. From the age of 9 to 15 months, the increase in the shoulder height was 13.3 cm – 13.1 cm – 13.1 cm. The captured data confirm our concern on in-breeding when feeding Kazakh Bactrian camels.

Table 6. Impact of female camels' technological parameters on the young camels' intensity of growth and development in the post-weaning period.

Parameters	Age	Process parameters		
		Degree of lactation full value, %		
		65-74	75-84	85 and higher
Body weight, kg	9 months	192.1±3.7	202.3±7.4	193.6±5.8
	12 months	231.5±4.2	239.9±5.7	234.9±8.1
	15 months	268.9±9.4	256.1±6.1	259.1±7.5
Height between humps, cm	9 months	142.4±1.1	137.5±0.9	139.3±1.2
	12 months	148.1±0.9	146.3±1.2	147.8±1.4
	15 months	155.8±1.5	154.6±1.1	155.2±1.3
<i>Milking capacity coefficient</i>				
		Up to 1.4	1.5-1.9	2.0 and higher
Body weight, kg	9 months	177.9±8.2	196.9±4.2	190.3±6.4
	12 months	236.4±5.7	236.2±6.4	231.9±8.2
	15 months	269.9±8.2	272.9±4.2	260.8±6.4
Height between humps, cm	9 months	139.2±1.3	145.1±1.1	141.4±1.1
	12 months	145.7±1.1	151.5±1.4	150.3±1.2
	15 months	152.3±1.2	158.2±1.3	154.5±1.6
<i>Fertility index</i>				
		Up to 42	42-47	47 and higher
Body weight, kg	9 months	181.6±6.2	191.5±3.7	172.1±8.5
	12 months	237.1±8.7	246.5±5.4	235.6±6.8
	15 months	271.6±5.9	281.3±4.3	275.4±9.2
Height between humps, cm	9 months	140.9±1.7	141.4±1.5	141.1±1.6
	12 months	143.4±1.5	148.1±1.8	146.8±1.4
	15 months	164.3±1.9	156.4±1.6	151.7±1.3
<i>Shorn wool amount coefficient</i>				
		Up to 0.8	0.9 -1.4	1.5 and higher
Body weight, kg	9 months	168.9±7.1	187.6±4.9	190.1±8.3
	12 months	221.3±5.8	245.1±6.2	233.7±6.8
	15 months	268.1±6.3	291.5±5.8	281.2±7.1
Height between humps, cm	9 months	131.3±1.7	139.5±1.3	147.1±1.5
	12 months	141.1±1.4	146.1±1.8	152.8±1.1
	15 months	151.9±1.3	155.4±1.6	164.3±1.3

In the post-weaning period, colts born from female camels with fertility index up to 42% grow more intensely compared with young camels of the same age, born from females with fertility index of 42-47%, 47% and higher. Form the age of 9 to 15 months, the height at the shoulders increases by 16.6%-10.6%-7.5%. As for the body weight, young camels with fertility index up of 47% and higher than 60.0% grow more intensely compared with young camels of the same age with 49.6% and 46.9%.

It means that there is no efficiency in selecting by fertility index of females of the basic stock. Thus, our statement on the necessity to procure breeders is confirmed. From the age of 9 to 15 months, young camels boosted their body weight: from female camels with shorn wool amount coefficient up to 0.8 – by 58.7%, with shorn wool amount coefficient of 0.9-1.4 – by 55.3%, with shorn wool amount coefficient over 1.5 – by 91.1%. The height between the humps prolonged by 15.7%-11.4%-11.7%. Thus, all the female camels are of wool and meat direction. The efficiency of estimating and selecting according to shorn wool amount in the facilities of 'Bayserke-Agro' Limited Liability Company, is now confirmed.

4. Conclusion

Down hair selection criteria are set for Arvana breed with down hair length of minimum 9 cm and fineness of 15-19 micron, and for Kazakh Bactrian breed down hair length of min. 12 cm and fineness of 14-18 micron. These criteria were used to select and form the preferable types according to the breeds, making 52 and 224 animal units correspondingly for further selection processing works to increase wool productivity in animal stocks.

Among Kazakh Bactrian camels, considering the elaborated criteria of down hair selection with the length of 12 cm minimum and fineness of 14-18 macrons, the preferable type includes 224 animal units, or 72.5%, which is 30.1% higher than those of Arvana camels. Consequently, the production of camel wool should be based on breeding of Kazakh Bactrian camels in the areas of industrial camel breeding.

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