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Bachelor thesis

Modern trends in camelid nutrition

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Declaration

I hereby declare that I have done this thesis entitled "Modern trends in camelid nutrition" independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In……..……..…… ……

Natalia Nikitina

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Author's abstract

In present study I attempted to summarize by literature review the available scientific information about nutrition and feeding camelids (*Camelidae)* and also compared the different requirements of each species for nutrients and considering the location and method of farming. Camelids are extremely valuable animals in the desert zone, semi-deserts and dry steppes. In recent years, the use of camelids as productive animals is becoming increasingly important. Camels and lamas are indispensable workforce capability for transport of people and things. Their importance is evident in many sectors and activities in urban and rural areas. Camels and lamas are good source of food as their meat and milk contains a lot of nutrients. They also provide materials suitable for further processing and utilization such as skin, wool and fiber. Last but not least they represent an essential part of local traditions and culture. Despite all these facts, there is only a limited amount of materials focused on husbandry of camelids. Especially the feeding and nutrition, which had the greatest impact on productivity. Nevertheless, camelids is adapted to the harsh conditions, to maintain the necessary working qualities, quick set of live weight and good productivity, camelids require regular full-fledged feeding. Although they have lower energy requirements than true ruminants and could efficiently digest low quality roughages because of the wide range of ruminal microflora. Nutritional requirements vary according to the season, type of content and sex of animal. It was proved that mineral content contributes to increase digestibility of nutrients. In conditions of free grazing of lamas and camels, the addition of vitamins and special mineral complexes to the diet is not required, but when animals are kept without free grazing, it is necessary to supplement mineral complexes for animals. Unlike camels, lamas are not able to lick. As a natural source of salts and trace elements, dry algae can be offered to lamas.

Keywords: camel, mineral complexes, alpaca, feeding, llama, nutrient requirements

Abstrakt

V této studii jsem se prostřednictvím odborné literatury a dostupných vědeckých článků pokusila shrnout informace o výživě a krmení velbloudovitých (Camelidae). Takže jsem se pokusila porovnat rozdílné požadavky různých živočišných druhů na výživu, kde jsem zohlednila lokalitu a způsob hospodaření. Velbloudovití jsou mimořádně cenná zvířata, která žijí v pouštích, polopouštích a suchých stepech. V posledních letech je stále důležitější využiti velbloudovitých jako pracovních zvířat. Velbloudi a lamy jsou nepostradatelnou silou pro přepravu lidí a zboží. Jejich význam je viditelný v mnoha odvětvích jak městských tak i vědeckých oblastech. Poskytují taky materiály vhodné na další zpracování a využití, jako je kůže a vlna. V neposlední řadě velbloudovití představují neodmyslitelnou součást místních tradicí a kultury. Navzdory všem zmíněným skutečnostem existuje jen omezené množství odborných materiálů zaměřených na hospodaření a pozici velbloudovitých v rozvojových krajinách a tropických oblastech. Hlavně o způsobu krmení, který má největší vliv na produktivitu těchto zvířat. Navzdory skutečnosti, že velbloudovití sudokopytníci jsou přizpůsobení k drsným podmínkám, si pro udržení potřebných pracovních kvalit, rychlého dosáhnutí dospělé hmotnosti a plné produktivity vyžadují náročnou starostlivost. Velbloudovití avšak mají nižší energetické nároky než jiní přežvýkavci a mohou účinně trávit krmiva s nízkou kvalitou, z důvodu širokého spektra mikroorganizmů v jejich trávicím traktu. Nutriční požadavky velbloudovitých se liší podle ročného období, typu oblasti kde žijí a pohlaví. Bylo prokázáno, že obsah minerálů přispívá ke zvýšení stravitelnosti živin. V podmínkách volného pasení lam a velbloudů není potřebné přidávání vitaminů a komplexních minerálů do potravy, ale pokud jsou zvířata držena bez volného pasu, je nutné jim do potravy přidat minerální komplexy. Na rozdíl od velbloudů lamy nejsou schopní lízat. Jako přirozený zdroj solí a stopových prvků mohou být lámům nabízena suchá řasa.

Klíčová slova: velbloud, alpaka, krmení, lama, požadavky na živiny

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LIST OF ABBREVIATIONS

ATP	adenosine triphosphate
$CoCl_2$	cobalt chloride
CP	crude protein
$CuSO_4$	copper sulfate
$FeSO_4$	iron sulfate
KI	potassium iodide
MJ	mega joule
$MnSO_4$	manganese sulfate
NFE	nitrogen-free extractives
TDN	total digestible nutrients
$ZnCl_2$	zinc chloride

1 INTRODUCTION

Camels and lamas are cloven-hoofed mammals (*Artiodactyla*), the only modern representatives of the suborder of the corpulent (*Tylopoda*), belonging to the family of *Camelidae* (Dorman 1986). The role of camelids as a productive animals is becoming increasingly important in recent years. This is all due to their multipurpose use and adaptability to severe and fodder conditions, which is very important for people, living in arid and semi-arid zones. With minimum costs people can obtain products with a low production cost (Iqbal 2001). Importance of these animals is evident in many sectors and activities in urban and rural areas. Camels and lamas are indispensable workforce capability for transport and excellent providers of meat, milk and materials, suitable for further processioning such as skin, wool and fiber. They also represent an essential part of local traditions and culture. The Andean Indians domesticated lamas more than 4 thousand years ago. And even today, lamas are the only way to transport goods to hard-to-reach mountainous areas of Andes (Ruchkina 2008).

In recent years, farms with camels and lamas spread all over the world. It is often directed not only to production, but also as entertainment for tourists, which is a very profitable business. Camel racing is an incredibly popular sight in Arab countries. It is a true national sport in which government invest a lot of money (Kempton 2012).

Despite all these facts, there is only a limited amount of materials focused on husbandry of camelids. As we know, the feeding and nutrition had the greatest impact on health of animal. It order to maintain the necessary working qualities, quick set of live weight and good productivity, camelids require regular full-fledged feeding with the addition of vitamins and special mineral complexes, if animals kept without free grazing.

2 AIMS OF THESIS

The aim of this work is to summarize current literature knowledge about nutrition and feeding camelids (*Camelidae*) in the tropics and in temperate climates. Another aim is to compare the different requirements of each species for nutrients and considering the location and method of farming.

3 METHODOLOGY

Review of literature on the subject was prepared on the basis of scientific and technical publications or publications of professional organizations. Scientific publications are sought mainly in the electronic databases using keywords. All literature was quoted by binding rules FTZ (FTA 2017). The work was written with the manual for writing undergraduate work FTZ (FTZ 2018).

4 LITERATURE REVIEW

The family Camelidae is divided into two genera. The genus camels includes three species: *Camelus dromedaries* – one-humped or Arabian camel, the *Camelus Bactrianus* – the two-humped camel and the wild Bactrian camel (*Camelus ferus*). The second genus is the llama comprising four species of the New World camelids are found in South America: the guanaco (*Lama guanacoe*) and the vicuna (*Vicugna vicugna*) are wild, whereas the llama (*Lama glama*) and the alpaca (*Lama pacos*) are domesticated (Murray & Skidmore 2005).

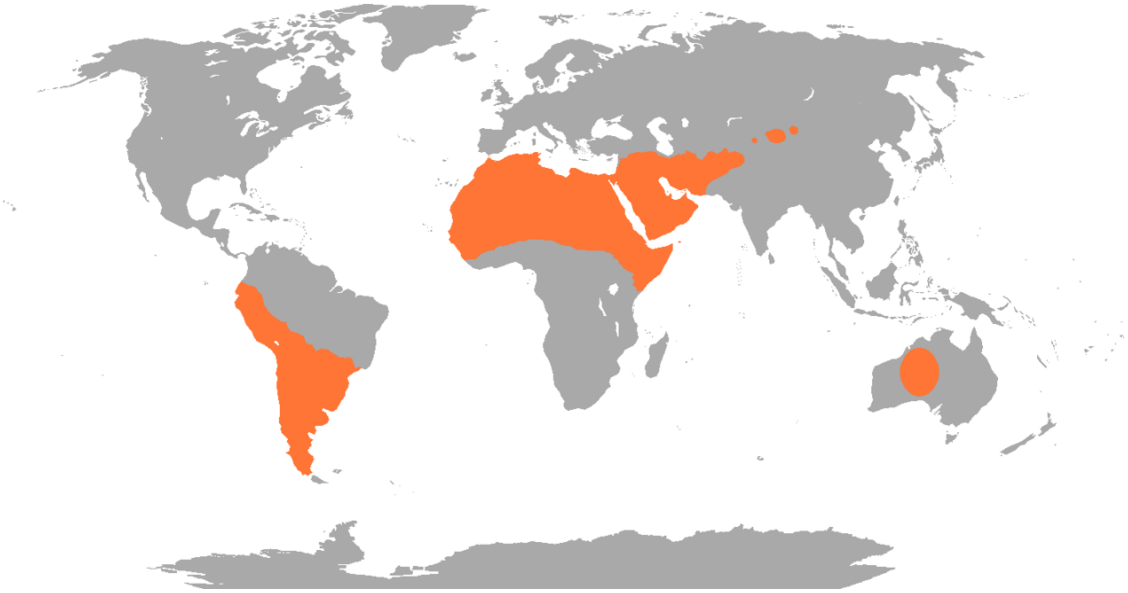

Figure 1: Current range of camelids, all species (Cooke & Bruce 2011)

4.1 Camels

The Dromedary or one-humped camel (*Camelus dromedaries)* is most widely distributed in the hot arid areas of the Middle East and Africa, whereas the Bactrian two-humped camel (*Camelus bacterianus*) is found in parts of central Asia and China (Dorman 1986). Modern distribution of both species of camels makes possible for us to judge about the centers of their domestication. Bactrian were bred on territory of Western China, Mongolia, Buryat-Mongolia, Kazakhstan, Uzbekistan, Kalmyk steppes. The wild two-humped camel *(Camelus ferus)* is critically endangered species of camel, which living in parts of northern China and Southern Mongolia (Ruchkina 2008).

On global basis there are about 28 million camels and there are 30 breeds of Asian and African dromedary, and as we can see on figure 2, the camel population increased in previous years (FAO 2018). Nevertheless, camel breeding is a poorly understood sub-sector of productive livestock production (Iqbal 2001). Baymukanov (1989) believes that productive camel breeding is a low-cost branch of desert livestock, which can provide the population of Central Asia with affordable milk and meat.

Diverse productivity of camels, which contain wool, milk and meat – is the result of selective breeding. Their high productivity is achieved by systematic artificial selection, carried out by mankind not one thousand years (Baymukanov 2004). Camels are multipurpose; females are used primarily as milk producers, the males for transport or draught. Both sexes providing meat as tertiary product. The genetic diversity and relationships amongst the dromedary populations are poorly documented (Murray & Skidmore 2005). Phylogenetic analysis (micro-satellite loci) showed that dromedary breeds can be classified according to countries (Mburu et al. 2003).

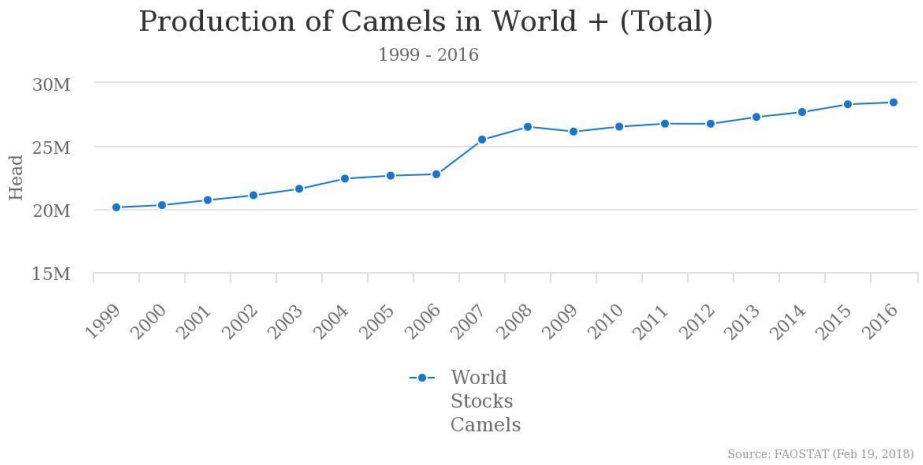

Figure 2: Production of camels in world (FAO 2018)

4.1.1 Ecological and behavioural adaptations

Kugenev (1982) notes, that camel's distribution zone is characterized by a desert landscape, a small amount water sources and precipitation, high solar insolation and a thin cover of drought-resistant plants. In anatomical and physiological terms, body structure of camels is slightly different from other species of farm animals. Camels have strong prehensile lips and narrow muzzle for its body size, which permits

it to feed on thorny plants. Mucous solid palate, tongue and cheeks have numerous hard papillae, tubercles and grooves, which serve to knead and grind food and also protect the mucous from damage by stiff spines (Sleeper 1985). It was stated, that camels are browsers, not grazers. They have long necks and legs and their feed mainly consists of shrubs, bushes and trees (3.5m above ground level). Also, it was observed that camel can survive indefinitely on browse (Sleeper 1985).

Feeding habits of livestock range from the grass dominated (96%) diets of cattle to browse dominated (95%) diets of camels, while sheep, goats and donkeys tend to be mixed feeders for herbaceous and non-herbaceous vegetation (Coppock et al. 1986). Camels and goats spent more than 80% of total feeding time on dicotyledons irrespective of season (Rutagwenda et al. 1990). Tripathi (1987) reported that camels should be allowed to forage for at least 6 hours a day, as they like to browse rather than graze and even if feed is plentiful, they cover large areas while foraging (Newman 1990). It was declared that camels are 'browsers' by nature, taking a bite from one plant and moving to another, covering vast areas each day in search of feed. It is reported that camels are browsers, with a split upper lip well suited for this purpose. Their lips are long and movable, the upper lip is bifurcated, and there are fangs on the upper jaw. Capturing the feed, the camel makes from 5 to 15 chewing movements of the jaws, superficially chops the food, sending it to the scar. They are selective feeders and eat the freshest vegetation available. They reach remote salt lakes where preferred plants have a high electrolyte and moisture content (Yagil 1990).

Camel's way of feeding was found entirely different from that of sheep and goats, which graze intensively. Camels taking only small portions of each plant rarely overgraze and constantly move. The average diet of camels consisted of dwarf shrubs (47.5%), trees (29.9%), grasses (11.2%), other herbs (10.2%) and vines (1.1 %) (Field, 1979). In their natural habitats, dromedary camels prefer browse of great nutritional value for most of the year in arid zones compared with grasses and herbs which have very short growing season (Mukasa-Mugerwa 1981). Camels have been seen eating charcoal, bones or even mummified young gazelles. Like other ruminants, they are not necessarily entirely vegetarian (Gauthier-Pilters & Dagg 1981).

Bactrian camels feed on specialized desert vegetation-halophytes, wormwood, shrubs, subshrubs and various thorny plants (Baimukanov 1989). It was indicated that during summer season, the Bactrian camels show a feeding preference for annual

and ephemeral plants and only when these dry off or disappear, the shrubs and legumes begin to dominate in its diet. Large evergreen bushes and deep-rooted trees are usually the only reliable sources of forage for camels during drought years and in dry season (Schwartz et al. 1983). In summer, two humped camels mainly depend on drought resistant plants like shrubs, sub shrubs, various species of legumes and halophytes (Baymukanov 1989).

4.1.2 Milk Camels

The dromedary and the Bactrian camel are known for their ability to produce milk for human consumption, in comparison to other species of *Camelidae*. In Africa, dromedaries are still considered as an important livestock species for milk production. The camel plays vital socio-economic roles and supports the survival of millions of people in the semi dry and arid zones of Asia and Africa (Wardeh 1990).

Dairy camels are characterized by high milk production, which is not less than 2500 kg/head/season under natural grazing conditions (Wardeh 1990). Based on milk production, camels can be classified into three groups: high, medium, and low. Only the high and medium milk-producing camels can be considered as true dairy camel types (Al-Shorepy et al. 2002). Milk production from camels is mainly practiced in pastoral migratory systems. Camel rising is conducted outside the agro system. Most camel herds are kept in natural pastures with little or no supplemental feeding. Differences in camel milk composition reported from different countries may reflect difference in breeds, nutrition and stage of lactation at sampling (Al-Shorepy et al. 2002). Camel (*Camelus dromedarius*) milk is a very important nutrient resource for humans in several arid and semiarid zones of subtropical and tropical regions where it represents often the only protein source. In hostile environment, where the availability of water is scarce and ambient temperature is very high, dairy camels are much better providers of high-quality protein than cows, sheep, and goats and they can provide milk almost all the year in quantities greater than other domestic animals. Nevertheless, the peak of lactation in camels tends to decline more steeply than in dairy cows (Al-Shorepy et al. 2002). Another advantage of camels is better ability to survive and produce milk during recurrent prolonged hot and dry periods (Bekele 2010). Camel milk contains 13.0-13.4% total solids, 4.2-4.5% lactose, 4.15-4.33% fats, 3.4-4% proteins, and 0.7-0.8% ash (Wardeh 1989). Milk production of camels can be

considered satisfactory considering the environmental situation and the feed availability. The addition of trace elements did not affect milk production and milk fat and protein content (Vittorio Dell'Orto et al. 1999).

4.1.3 Meat Camels

Meat camels are characterized by the development of the hindquarters, rigid body, large humps, relatively short neck and large head, and heavy bones and muscles (Wardeh et al. 1990). The role of the camel as a meat producer is becoming more important, because camel is a good source of meat especially in areas where the climate adversely affects the performance of other meat animals (Kadim et al 2013). This is because of camels unique physiological characteristics, including a great tolerance to high temperatures, water scarcity, solar radiation, rough topography and poor vegetation (Kadim 2007). Camel carcass can provide a substantial amount of high quality meat for human consumption, which is not inferior to beef. There is a high demand for camel meat to be used in meat products even in societies not rearing camel. The low fat content with relatively high polyunsaturated fatty acids, high proportion of good quality proteins rich in essential amino acids, high moisture contents, low level of cholesterol and high level of vitamins especially vitamin B complex. It makes camel meat a healthy food for humans (Kadim et al. 2008). Moreover, the high water holding capacity of this meat is giving it a good processing properties (Yousif & Babiker 1989) that's why camel's meat can be recommended as an important raw material for production of many meat products (Kadim et.al. 2013). The most important trouble associated with this meat is its higher connective tissue content, which makes it a tougher kind of meat. Fat from the humps of a camel is also an important food product. In a number of places, it is eaten raw immediately after slaughter, while it is still warm, but the fat that is cooled goes only to the felling (Kadim et al. 2013).

4.2 New World camelids

The genus of Lamas is divided into four types: lama, alpaca, guanaco and vicuna. Two of them are domesticated – llama and alpaca, and two other species are in a wild state – guanaco and vicuna. The Lama family is common only in South America. Before the arrival of the Spaniards, the lama was the only transport animal

of the Indians of South America (Ruchkina 2008). The lama and alpaca are mainly used for meat and fiber production, they also used as pack animals. Lamas are well acclimatized in the conditions of zoos (Root-Bernstein & Svenning 2016).

It has been paid little attention to lamas in comparison with the research conducted worldwide in other species. It was only during the last few decades that llamas and alpacas spread all over the world, gaining interest of the international scientific community because of their use as companion animals as well as for the production of high-quality fiber. The vicuna (*Vicugna vicugna*) is the smallest of the South American camelids and has the finest fibre coat (Fowler 1998). On global basis there are about 9 million camelids and as we can see on figure 3: the camelid population increased in comparison with previous years (FAO 2018).

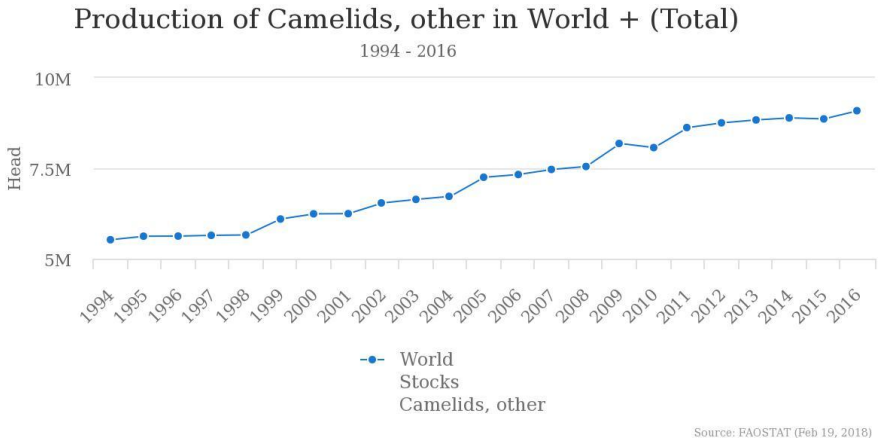

Figure 3: Production of New world camelids in world (FAO 2018)

4.2.1 Wool productivity

Alpacas are mainly bred for the production of wool (Fig. 5 and 6). They have a high variability of wool – from 9 to 4 kg per head per year with an average wool productivity of 1.8 kg. A highly reliable correlation between the body weight of an animal and the amount of a wool has been noted (Van Saun & Herdt 2014).

Figure 4: Alpacas in winter (source: https://www.instagram.com/russian_alpacas/)

Figure 5: Alpacas in summer after after shearing (source: https://www.instagram.com/russian_alpacas/)

Llamas produce coarser wool than alpaca, and it is used mainly in the country where it is produced and not exported. An average wool productivity is also 1.8 kg per year, although the lamas do not cut as regularly as alpaca (Ruchkina 2008).

4.2.2 Meat production

Alpacas meat is similar in taste and nutritional properties to lamb. Meat of young animals even surpasses the taste of lamb meat. However, in practical conditions only adult animals go to slaughter. Adult 3-year-old males have a body weight of about 76 kg, females – about 65 kg. The slaughter yield can reach 60% of the total yield (Van Saun & Herdt 2014).

5 NORMS OF FEEDING CAMELIDS

Camelids are not true ruminants because they have 3 distinct stomach compartments (C-1, C-2, C-3) as opposed to the 4 distinct stomach compartments of ruminants. The organism of camelids is adapted to the harsh conditions of dry steppes, semi-deserts and deserts. Camelids have lower energy requirements than ruminants, because an efficient mechanism for nutrient recycling was evolved (Kempton 2012). However, as with ruminants, dietary considerations concern not only the health of the overall animal but also the health of the microbes in the first stomach compartment (Bennett & Richards 2015). A rational system for feeding young animals, taking into account the biological characteristics of animals, should promote normal growth, development, the formation of high productivity and a strong constitution. Feeding rates and approximate rations are made taking into account the live weight, age of animals and increment (Baymukanov et al. 2006) and it is advised to separate animals in groups and feed them based on their individual needs, to ensure that each animal receives the proper amount and quality of nutrients. Feeding groups can include breeding males, lactating females, pregnant females, non-reproductive females and geldings (Bennett & Richards 2015). In their native land, camelids forage widely to get enough to eat and therefore do not naturally compete for food. In view of this, feeding arrangements that require animals to eat in close contact cause stress and might prevent some animals from having access to adequate amounts of food, so it is better to provide more feeder space for animals (Bennett & Richards 2015).

Example animal groups and suggested feeding plans for camelids (according to Bennett & Richards (2015)):

- **Lactation** – From 12% to 14% crude protein (CP), 60% to 70% total digestible nutrients (TDN). Highest nutrient needs; high-quality forage plus supplementation, including minerals and vitamins as appropriate;
- **Growth** – From 14% to 16% CP, 55% to 65% TDN. Highest nutrient needs; high-quality forage plus supplementation, including minerals and vitamins as appropriate;

- **Maintenance** (Males older than 1 year, pregnant females in months 1 to 8, breeding females) -.From 8% to 10% CP, 50% to 55% TDN (up to 60% TDN for breeding males). Low nutrient needs, low-quality to moderate-quality forage, minerals and vitamins as appropriate just for pregnant and breeding females;
- **Late pregnancy** (Pregnant females in months 9 to 11) -.From 10% to 12% CP, 55% to 70% TDN. Moderate-quality to high-quality forage plus mineral and vitamin supplementation;
- **Sub maintenance** (Obese animals, unless pregnant animals) – From 8% to 9% CP, 45% to 33% TDN. Lowest nutrient needs; low-quality forage plus mineral and vitamin supplement only.

5.1 The ratio of nutrition in full-fledged diets

Selection of nutrition depends on the chemical composition of feed and total digestible nutrients in the digestive tract of animals (Bennett & Richards 2015). Feeds are evaluated for the presence of dry matter, crude protein, raw fat, carbohydrates – raw fiber and nitrogen-free extractives (NFE) – nutrients, as well as the amount of minerals (raw ash) – macroelements (calcium, phosphorus, potassium, sodium, chlorine, magnesium, sulfur) and trace elements (cobalt, iodine, manganese, zinc, iron, selenium, copper, boron), and also vitamin nutrition of fodder (Vittorio Dell'Orto et al. 2000). Nutrition is one of the most important and controllable management factors influencing production and reproduction (Senger 2001). Fresh, clean water should always be provided as vital component of proper camelid nutrition (Bennett & Richards 2015).

5.2 Dry matter

One of the most important normalized indicators of animal rations is dry matter. Dry matter is an indicator of the amount of nutrients that are available to the animal in a particular feed. The main component of the dry matter is carbohydrates. Camelids have a lower dry matter intake than horse and sheep, They typically consume only 1.7% of bodyweight as dry matter, compared with 3-4% bodyweight for horses and cattle. Camelids require 70% of dry matter intake as roughage, because they typically have higher digestibility coefficients compared

with ruminants. Camelids can efficiently digest low quality roughages because of the wide range of ruminal microflora, which can adapt to a range of forages (Cahill & McBride 2003).

5.3 Carbohydrates

Carbohydrates are an important component of the dry matter of the diet; at the expense of them the greater part of the need for energy of camelids. It is a very diverse compilation of organic compounds that comprise more than 70% of the camelid diet (Van Saun & Thomas Herdt 2014). Simple carbohydrates (pentoses and hexoses) are the most mobile and easily mobilized when moving and performing work.

Raw fiber consists of cellulose, a part of hemicelluloses and inlaying substances (lignin, utin, suberin). Microbial fermentation of cellulose occurs in the digestive tract of ruminants with the formation of final products – acetic, propionic and butyric acids and gases – methane and carbon dioxide (Van Saun & Thomas Herdt 2014).

Sugar is a large group of organic compounds that are divided into monosaccharides – pentoses (arabinose, xylose, ribose) and hexoses (glucose, galactose, mannose and fructose); disaccharides (sucrose, lactose, maltose); trisaccharides (raffinose) and tetrasaccharides (stachyose). The blood glucose concentrations and hormone glucagone in camels are much higher than in ruminants and horses, despite having a ruminant pattern of digestion which does not yield glucose for absorption (Fattah 1999).

Camelids produce greater quantities of glucose compared with true ruminants, presumably as a survival mechanism. This allows camels to produce higher levels of ATP from glucose for muscular function and emphasizes the importance of feeds that can provide substrates for glucose and gluconeogenic amino acids (Cahill & McBride 2003).

5.4 Fats

Over the past years the number of supplementing ruminant diets with supplemental fat has has been increased (Hadipour et al. 2014). In 1929, the role of linoleic, linolenic and arachidonic acids in the metabolism of the body was proved,

and from this time these acids are considered like indispensable. Lipids can be supplied in an animal diet through various feed sources: oil-rich cereals, oilseeds or fish oil (Kadim et al. 2002). Rich sources of linoleic acid are oilseeds and full-fat flour (mainly soybean). Flax seeds are also good source of linolenic acid. In some cases, rations of animals are enriched with vegetable oil (usually concentrates). Also used fats of animal origin (pork, beef, horse) – fat mesenteric, subcutaneous, a mixture of animal fats of different types and vegetable oils (Hadipour et al. 2014).

5.5 Mineral substances in diet

Microbiological processes are dependent on the concentration of ash substances in the contents of the rumen. It was proved that mineral content contributes to increase digestibility of nutrients (Bennett & Richards 2015. In conditions of free grazing of lamas and camels, the addition of vitamins and special mineral complexes to the diet is not required, but when animals are kept without free grazing, it is necessary to supplement mineral complexes for animals. Tables 1 and 2 show the need for camels and lamas of different kinds in microelements and vitamins for captive content. Mineral substances are a necessary component of the diet of animals. With insufficient intake or absorption of a mineral substance, the symptoms of a specific mineral deficiency develop the productivity and reproductive capacity decreases. The mineral composition of fodders depends on the area where fodder crops grow (Hadipour et al. 2014).

The kind of the feed has a significant effect on the digestibility of the nutrients of the diet. For example, nutrients of haylage from clover is digested much better, while the enrichment of rations with mineral nutrients helps to increase the digestibility (Van Saun & Thomas Herdt 2014). Control over the mineral nutrition of animals should be applied not only on admission, but also on the degree of their use and deposition of the stock in the body. In addition to zootechnical methods of monitoring the mineral nutrition of animals, biochemical indices of blood, milk and hair are widely used (Abdykalikova 2000). Control over the mineral and vitamin composition of the diet is especially important in the artificial cultivation of camels (Cahill & McBride 2003). Quite sensitive to the mineral component of the diet, camels and llamas with a lack of trace elements, table salt and calcium can eat mineral fertilizers or their own bowel movements. Treatment consists in the single appointment

of salt laxatives, the appointment of probiotic drugs. Symptomatically used drugs that support cardiac activity. It is necessary to correct the diet for macro and micronutrient composition (Baraka 2012). Diseases of metabolism in the corpulent are often rickets (lack of calcium, phosphorus and vitamin D3 for their assimilation), dry skin (lack of vitamins A and C) and loss of hair (lack of microelement of cobalt). In 2017, a lama of seven years was clinically diagnosed with rickets, which manifested itself including the softness of the caudal vertebrae and even twisting the tip of the tail into a spiral with a diameter of 2 cm (Aronov 2017).

Nutritional importance of selenium for camels was proved (Faye & Seboussi 2009). In some areas soils are deficient in selenium and it is recommended to add supplementation with oral or injectable minerals. In other geographic locations, selenium can reach toxic levels through feeding certain grass hays (Bennett & Richards 2015). Deficiency of selenium in feeds causes a specific pathology, the so-called "white muscle" of young animals, and excess – a toxicosis called "alkaline disease" A deficiency of selenium in diets can be prevented by feeding sodium selenite or vitamin E (Faye & Seboussi 2009).

In addition to absolute amounts of mineral substances in diets, it is important to control the ratio of acid (phosphorus, sulfur, chlorine) and alkaline (calcium, magnesium, potassium and sodium) elements – acid-base balance – the ratio of the sum of acidic and alkaline gram-elements. The optimum norm of acid-base balance in animal diets is 0.8-0.9. Forages with alkaline ash include coarse fodder, root crops, haylage, green mass; acid reaction of ash – all grain feeds and products of their processing (Cahill & McBride 2003).

Table 1: Average doses of trace elements for camelids per animal per day, mg

	KI	$CoCl_2$	$ZnCl_2$	$MnSO_4$	$CuSO_4$	$FeSO_4$
Camels	7,5	20	60	140	100	400
Alpaca, guanako	1,15	4	12	28	20	80

Source: Aronov, (2017)

Mineral supplements are usually salt based to limit intake and contain variable concentrations of trace minerals and possibly fat-soluble vitamins. Indirectly,

this mineral complex can be given to other species of corpulent, based on their mass. These trace elements are given in aqueous solution together with concentrates for a month, followed by a 30-day break (Aronov 2017).

Table 2: Average daily amount of mineral substances, kg

	Chalk	Salt
Camels	0,1	0,1
Lama, alpaca	--	Lick
Guanaco, vicuna	0,02	0,02

Source: Aronov, (2017)

Table 3: Average doses of vitamins for camelids per animal per day, mg

	A*	D_3*	E*	B_1	B_2	C
Camels	38000	8000	4	--	--	--
Guanaco	26000	1500	0,75	12,5	10	350
* A, D3, E – international units, ** – B1, B2, C – micrograms;						

Source: Aronov, (2017)

As a natural source of salts and trace elements, llamas can be offered dry algae – laminaria, agar and some others. Guanaco and vicuna in nature eat various mosses and lichens, so their diet can be varied with local mosses (Faye & Seboussi 2009).

Mineral supplements are usually salt based to limit intake and contain variable concentrations of trace minerals and possibly fat-soluble vitamins (Aronov 2017).

5.6 Exemplary rations for camels

A rational system for feeding young animals, taking into account the biological characteristics of animals, should promote normal growth, development and the formation of high productivity and a strong constitution. Feeding rates

and approximate rations are made taking into account the live weight, age of animals and increment (Table 3, 4 and 5) (Baymukanov 2009).

When calculating the needs of growing animals in nutrients, we must proceed from the following data (according to Baymukanov 2009):

- for 100 kg of live weight to plan a 1.5-1.7 of energy feed unit;
- for 1 energy feed unit in the rations provide:
  - dry matter -1.9-2.3 kg;
  - digestible protein – 104 g;
  - table salt – 9.5;
  - calcium – 10;
  - phosphorus – 5.8;
  - sulfur – 4.2 g;
  - carotene – 51 mg.

Rations of young animals in winter, except pasture grass, consist of 3-4 kg of hay and 1.3 kg of concentrated feed, and in the summer period from 16-21 kg of pasture grass and 1.9 concentrates (Baymukanov et al. 2006).

Table 4: Feeding norms for young camels, per head per day

Indicators Indicators	Age, months				
	18	24	30	36	42
	Live weight, kilograms				
	300	350	400	450	500
Energy feed unit	6,0	6,3	7,4	7,5	8,7
Exchange energy, MJ	59,8	62,6	74,9	75,3	86,5
Dry matter, kg	6,81	7,98	8,39	9,00	9,68
Crude protein, g	768	849	901	984	1000
Digestible protein, g	497	526	586	630	860
Crude fiber, g	1901	2264	2310	2610	2680

Source: Baymukanov, (2009)

Table 5: Exemplary rations for camels, per head per day (summer period)

Feed and nutrition of rations	Age, months		
	12-18	24-30	36-42
	Live weight, kilograms		
	300	400	500
Pasture motley grass, kg	15,9	19,0	20,8
Barley meal, kg	1,4	1,9	2,5
Mineral dressing, kg	0,183	0,328	0,336
The diet contains: dry matter, kg	6,89	8,43	9,60
Energy feed unit	6,1	7,5	8,7
Exchange energy, MJ	61	75	87
Crude protein, g	780	919	1046
Digestible protein, g	506	594	689
Crude fiber, g	1989	2390	2641

Source: Baymukanov, (2009)

Table 6: Exemplary rations for young camels, per head per day (winter period)

Feed and nutrition of rations	Age, months	
	18-24	30-36
	Live weight, kilograms	
	350	450
Pasture wormwood-saltwort, kg	12,1	13,3
Hay of alfalfa, kg	2,3	3,4
Barley meal, kg	1,1	1,3
Mineral dressing, kg	0,230	0,244
The diet contains: dry matter, kg	8,13	9,75
Energy feed unit	6,31	7,56
Exchange energy, MJ	63	76
Crude protein, g	840	994
Digestible protein, g	540	646
Crude fiber, g	2295	2755

Source: Baymukanov, (2009)

6 HYGIENE AND FARMING

The health and productivity of farm animals largely depend on the conditions of their maintenance. After all, 6-8 months a year, and sometimes a whole year the animals are in the premises. Therefore, great importance is attached to the construction and use of livestock buildings. Maintenance of animals in premises, that meet the requirements of animal hygiene, allows economical use of feed, improve the productivity of animals and their natural resistance to disease. Conversely, keeping in uncomfortable and cold premises, moist, dark and dirty always leads to higher feed costs, reduced productivity and the spread of respiratory and digestive diseases among animals (Aronov 2017).

Bactrian is well adapted to live in a sharply continental dry climate with hot and dry summers and very frosty and snowy winters. Characteristic for camels, anatomical and physiological features allow him to spend extraordinarily long without water and be content with the most crude and malnutriate food. The two-humped camel also tolerates severe winters relatively easily thanks to exceptionally thick wool. However, it categorically does not tolerate dampness and is found only in areas with the driest climate (Baymukanov et al. 2006).

6.1 Pasture maintenance of camelids

There are two variants of pasture content: free grazing and corall form of grazing. The least productive for camels is the free grazing, when the herd is given free movement through grazing. Of course, this method does not require any work on the organization of pasture, and due to the unpretentiousness of camels, they can be kept on any suitable territories. But in this case it is necessary to involve simply huge areas. The camel herds will be at a great distance from each other and from the main buildings, the communication between individual herds and the base will be difficult. It means that there will not be the opportunity to react to the onset of the illness in a timely manner or other abnormal situation (Baymukanov 2009).

The second way is a corral form of grazing. This method involves the separation of the entire range of pastures into separate areas. Grazing is carried out gradually, as the grass is bled in one section, animals are transferred to another. During the time when one of the areas "rest" the grass on it has time to grow. This method makes it possible to reduce the size of pastures and to bring individual flocks closer

to each other and to the base. Feeders and drinking bowls should be placed in such a way that the distribution of food is possible without entering or entering the territory of the walking area (Baymukanov 2009).

During pasture period in summer, when camels are given full grazing, it is necessarily to present water source. For a day the camel can drink more than 20 liters of water (Iqbal et al. 2011).

6.2 Premises for camelids

As a rule, the camel farms, oriented to the pasture-stabling maintenance of animals, is formed in the form of a complex of buildings and structures, which includes: feed mill, production facilities, premises for keeping camels with foraging and feeding areas, ancillary premises and buildings of the veterinary center (Baymukanov et al. 2006).

It is necessary to observe a number of rules placing this complex on the ground. It is important to orient buildings in view of the terrain and the wind rose. Placement of the feed mill should be carried out at a minimum distance to the camel feeding areas. These buildings need to be connected by convenient passage to avoid unnecessary costs of transportation of feed (Abdykalikova 2000).

Camel breeding objects are divided into tribal and commodity ones according to their purpose. Tribal objects are intended for the reproduction and cultivation of pedigree youngsters in order to improve the productive qualities of existing breeds of camels .Commodity objects are intended for the production of meat, milk and wool (Baymukanov 2009).

There are also a number of requirements for the arrangement of premises for the maintenance of camels. Housing provided can vary from a basic run-in shed (3-sided) structure to an enclosed barn with or without stalls (Fig. 6 and 7). Camelids are highly visual and seem to prefer a less closed-in environment, thereby retaining the ability to identify threats intact. In general, porches attached to a barn are more desirable and more fully used than the inside of the barn. Shelter should provide protection from rain, ice, and snow and also should provide critical shade in hotter temperatures as well. It is also important to provide proper ventilation to the animals health and well-being. In hot climates, fans are helpful for cooling and insect control (Bennett & Richards 2015).

Figure 6: Simple barn with panels used as dividers (Polansky 2015)

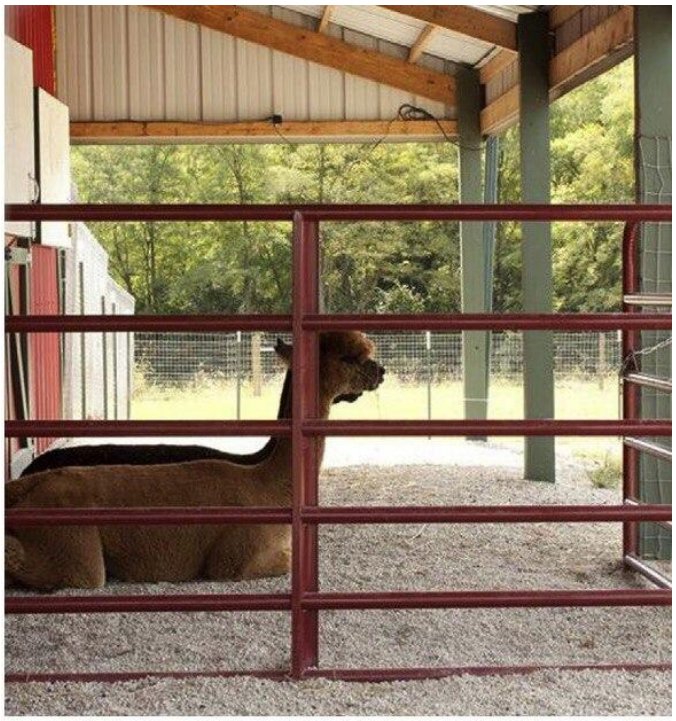

Figure 7: Porches are the preferred loafing spot for camelids (Polansky 2015)

6.3 Systems of farming

In camel breeding, two content systems are used – pasture and pasture-stall. Pasture maintenance system is used in commodity enterprises. With this system of maintenance, camels are on pastures in herds all year round. In winter they are fed

with coarse and concentrated fodder. To cover camels in rainy and cold weather, shelter with canopies should be provided (Baymukanov et al. 2006).

Pasture-stall maintenance system is used at dairy and breeding enterprises. The duration of the stall period is 120 days, including 60 days of the pasture and feeding (Baymukanov et al. 2006).

6.4 Main factors of the environment, influencing the organism of camelids

The main factors of the environment that affect the body of camelids include water, air, light, litter. The growth and development of animals is influenced by genetic factors and sex. Males grows faster than females and at the same age they have larger sizes and larger body weight, from the conditions of the environment – feeding, maintenance, light, temperature, exercise and other (Bennett & Richards 2015). The most powerful factor affecting the growth and development of the body is feeding, not only the quantity and quality of feeds, but also their types (Van Saun & Thomas Herdt 2014).

For example, for the formation of a physique characteristic of dairy cattle, it is important to feed coarse fodder from the earliest possible age (8 to 10 days). From 30 to 40 days old should be included hay and juicy fodder in the diet. Such food contributes to the development of digestive organs, which provides food for a large number of juicy and large fodder and helps to increase the yield of milk. For young animals with meat direction milk should be given in large quantities and concentrates. It is contributes to the formation of broad-bodied meat animals (Kadim 2007).

Low and high air temperatures have an unfavorable effect on the organism of animals. This factor can affect the decline in growth, milk production decrease, fertilization of and overall health of the animal (Aronov 2017).

In case of inadequate lighting, mineral, protein and carbon-fat metabolism is disrupted. This can cause disturbances in the growth of animals and the development of bone tissue. It is necessary to create an optimum microclimate, adjusting the temperature, humidity and gas composition of air and light in premises. An unfavorable microclimate (as a permanent factor) can have a negative effect on animals and be one of the main causes of the occurrence of various respiratory diseases among animals (Aronov 2017).

6.5 Litter

Litter is used to maintain the dryness and cleanliness of the floor in the premises and to provide the animals with a soft and warm bed. Good litter should be distinguished by softness, purity, high moisture capacity, the ability to absorb water vapor from the air and have a low thermal conductivity. There are several types of litter used to cover the floor of stalls for camelids. Each type has its pros and cons. (Bennet & Richards 2015).

6.5.1 Straw

The most popular and economical is straw. Many farmers prefer to use it, because it is undoubtedly the warmest, softest and easily transmits moisture. It is easy to get, although in rainy years it can become scarce. For camels, wheat straw is better suited, which is not as edible as barley or oat. Another advantage of straw is that it is easier to get rid of it than from some other types of litter: it can be burned (in a safe place away from the stables, sheds with hay, etc.) or can be used as a compost (Baymukanov et.al. 2006). The main drawback of straw is that it can contain a lot of dust or fungal spores, causing some camelids to have an allergy leading to respiratory diseases. The first sign of a similar problem is a cough (Aronov 2017).

6.5.2 Sawdust

Another popular litter in our day is sawdust. When properly handled, they ensure the cleanliness and hygiene of the litter that camels do not eat. There is no spores in sawdust, and if there is no dust in it, sawdust can be a good alternative to straw for camels with any kinds of respiratory diseases. However, sawdust also has its drawbacks. It is difficult to get rid of: it slowly rot and it can not be scattered on the ground. In addition, it is possible to get into them foreign things, glasses, nails or chips, although this does not happen with high-quality sawdust. Sawdust may contain chemicals that treated trees, and this can cause skin irritation or hoof disease in some camels. Unlike straw, which contains air, sawdust is quickly compressed. Therefore, the litter of sawdust is not as warm as litter of straw, and it is less pleasant to lie on it, in addition, the sawdust is mobile, so the animal can easily be on the bare floor (Baymukanov et al. 2006). In addition, sawdust is not recommended for lamas,

because it contaminate the fiber and it is difficult to remove. A sand substrate that can be soaked with water in the summer helps with cooling. Rubber mats, straw, and similar substrates are appropriate for lamas (Bennett & Richards 2015).

7 RELEVANCE OF THE TOPIC

Camelids, being adapted to existence in severe climatic and fodder conditions, are able to use pastures throughout the year without prejudice to other species of farm animals. This makes it possible, with minimum costs, to obtain products with a low production cost, which is very important for people, living in arid and semi-arid zones. And also we should pay attention to the following issues, restraining the development of camel breeding.

1) Low share of breeding stock of camels;
2) Small-scale production;
3) Insufficient popularization of camel breeding products and research of their medicinal products;
4) Underdevelopment of technology for the production of camel production.

8 CONCLUSION

Camels are famous for their stamina and unpretentiousness. It is known that out of 50 plants growing in the desert, camel can eat more than 30 species. Even prickly bushes and plants with a sharp unpleasant taste, such as wormwood, go to the food. Wild camels can drink brackish water, but the domestic ones have lost this ability and need quality fresh water. Despite the fact that camels can do without food for up to a month, and without water for up to two weeks inclusive, to maintain the necessary commodity condition, working qualities, quick set of live weight and good milk yield, camels require regular full-fledged feeding.

In camel breeding, two content systems are used – pasture and pasture-stall. Pasture maintenance system is used in commodity enterprises. Pasture-stall maintenance system is used at breeding enterprises and dairy enterprises. Choosing the location should be based on the fact, that in a warm climate it is cheaper to content animals, because the year-round grazing is possible. But also we must start from the productive orientation of the farm.

Based on the studies carried out to study the effects of different levels of rationing of camels, the following conclusions can be drawn:

1) Feeds fed to camels are characterized by extreme variety in nutrient content. In general, it is possible to replace the very high content of fiber and dry matter in the stall period and the low protein and carotene content. Fodder plants of the steppe zone represent an extensive and diverse group with a highly fluctuating content of all nutrients. The nutritional value of the pasture grass of the semi-deserts depends on the season of the year: so the pasture grass of the winter period is characterized by a low content of protein and carotene. The content in feeds of mineral substances is unstable and depends on the natural and climatic conditions, the period of maturation;
2) The average daily need of grass for camel varies depending on the nature of the pastures, within the range of 22.3 – 29.2 kg. In winter, a significant portion of the energy from the feed is spent on maintaining body temperature. During the stall period, the consumption of hay, depending on its type, up to 5 kg, mixed herbage of up to 10 kg and concentrates up to 5 kg, or up to 15 kg of haylage and 3.0 kg of mixed fodder. This indicates an important biological

trait of a camel – it is more economical to use supplemental nutrients in comparison with other agricultural animals;

3) According to the ability to digest the nutrients of feed, under the same conditions of maintenance, camels, both adults and young, outnumber cattle, sheep, and especially horses. Digestion of organic substances is at a fairly high level, reaching 59.59 – 73.74%. Fiber digested pretty well (52.48 – 77.50%). Coefficients of digestibility of nutrients of pasture grass with year-round pasture content in all groups was higher in winter, so the digestibility of organic substances is 76.97 – 78.92%, fat 64.52 -71.87% and fiber 74.77 – 81.41% . The digestibility of fodder for camels depends mainly on the nature of the feed: the digestion of haylage from clover is higher than the digestion of nutrients from wormwood hay and mixed herbage;
4) The exchange of basic macro- and microelements in camels depends on their quantity in the feed;
5) The nature of the feed does not significantly affect the content of the main macro- and microelements in the blood, milk, hair follicles;
6) The nature of the feed had an effect on the fat content of milk. Thus, the fat content of camel's milk is on average 5-7%;
7) The nature of the feed and the normal feeding of camels had a favorable effect on the change in the live weight of animals: thus, despite the relatively high weight gain in animals in the pasture period, the decrease in the live weight of camels in the stall period was significantly lower;
8) Timing of the content spent in the stall and pasture period on lactating and foal camels, as well as on camel producers, made it possible to establish that camels, in comparison with other animals, spend much less time on pasture and watering.

Unfortunately, little researches has been done in feeding and requirements for nutrients of the lamas and it has been paid little attention to lamas in comparison with the research conducted worldwide in other species. Unlike camels, lamas are not able to lick. As a natural source of salts and trace elements, dry algae can be offered to lamas. Therefore, it is impossible to draw accurate conclusions and comparisons between camels and lamas.

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