

FACTORS WITH AN IMPACT ON THE COMPOSITION OF COLOSTRUM AND DONKEY MILK

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REVIEW

Abstract

Donkey milk is of increasing interest lately, thus being studied in depth its physicochemical compositions. Colostrum of this species has proven to be rich in nutritional principles, and its composition defines it as called a functional food. Also, as in the other milk-producing species, the composition and the quantity obtained, it is dependent on a multitude of factors, among which were highlighted during the studies, the breed, the stage of lactation, the state of health of the female, the time of collection and external factors such as season, temperature and light. The quality of donkey colostrum shows changes during the lactation period, being thus much richer in nutritional principles in the innate health of the udder of this species beneficially influences the quality of milk and colostrum compared to other farm animals. Due to the research carried out, the beneficial qualities of this product have been discovered and all the time the benefits that it would have on human health.

Keywords: donkey, colostrum, physicochemical compositions, stage of lactation, external factors

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INTRODUCTION

The breeding of donkeys has become an activity that is quite common lately, especially in Italy, donkey milk and colostrum, being a production used to improve the quality of human health and in the creation of pharmaceutical and cosmetic products, which as a result of studies have been found to be beneficial (Perrucci S., et al., 2021).

Being tolerated much better to by people who suffering from certain allergies and intolerances of milk and milk compounds, this species has aroused interest especially for the use in children diet and for people who have higher sensitivity (Sarti L., et al., 2019).

Donkey milk and colostrum are alternative milk sources, resulting from various studies, that being similar to human milk, it is suitable for people who are intolerant to other species milk (Salimeri E., et al., 2013).

Donkey colostrum is rich in protein, immunoglobulins, peptides, hormones, growth factors, prostaglandins, cytokines, minerals and

vitamins, especially in vitamin D (Jain G., et al., 2020).

The components of milk and colostrum change with period of lactation, so they are much more abundant in the first hours after calving, after which they gradually decrease by the end of this period (Jain g., et al., 2020).

Another reason that aroused interest, regarding the colostrum of this species, was its inclusion in the human diet (Martini M., et al., 2020).

In addition to the qualities, it has on human health, it has been shown from studies that colostrum and donkey milk contribute beneficially to the quality of frozen semen of the species *Equus asinus*, bringing a beneficial nutritional contribution to sperm (Martini M., et al., 2020).

PROPERTIES AND BENEFITS OF DONKEY COLOSTRUM

Colostrum is the natural product emitted by mammals, which is found in the first days of lactation (Machiş Z., et al., 2018).

Mainly, colostrum is used by newborn donkeys, being rich in essential nutrients, having a role in the process of growth and development, participating through components in the immunological and anti-inflammatory processes of the body, being therefore necessary in the first 6 hours of life, to confer the passive immunity of donkey foals (Martini M., et al., 2020).

Colostrum comprises large amounts of immunoglobulins, immunomodulatory and antimicrobial factors, lactoferrin, lactoperoxidase, oligosaccharides, lysozyme and fats, while lactose is found in lower quantities compared to its content in mature milk (Turini L., et al., 2020).

The presence of protease inhibitors, which belong to the large family of serine proteases, have been identified in colostrum, as a result of studies by Han Y., et al., 2020, the presence of protease inhibitors, which belong to the large family of serine proteases, which contribute to strengthening the immune system, helping even to protect the body from HIV infection.

Also, among the important properties over the years, it was discovered that donkey colostrum, has an influence on breast cancer and tumors in mice, this being determined by means of metabolic analyzes discovering over 476 possible metabolites, being determined by this study, the anticancer properties of donkey milk and colostrum (Li Q., et al., 2020).

Experience has shown that following the administration of donkey milk and colostrum, experimental batches of mice that had tumors at different stages in the lung and liver, their growth was reduced with the consumption of milk and colostrum while, the body weight was not affected, this also determines the anticancer properties of milk and colostrum of this species (Li Q., et al., 2020).

As for the mineral content in donkey colostrum, it is similar to the mineral content in mare's milk, but certain differences have been found, such as higher amounts of iron in the donkey compared to mares and higher amounts of zinc in colostrum than in milk (Licitra R., et al., 2019).

Due to the placental type of donkeys, which is diffuse, epitheliochorial and contains various microplacentom, the foals of this species require a high amount of colostrum, containing a serum concentration of immunoglobulins, and its low consumption in

the first hours of life has a negative effect on the health of newborns (Polidori P., et al., 2022).

The contribution of the beneficial properties of colostrum are brought in the first months of life, but its effects are felt throughout the life of individuals (Polidori P., et al., 2022).

Donkey colostrum has been determined to be much richer in nutritional and immunological principles compared to the milk of other species, so its properties are similar to those of human milk, due to the macro similar composition (Marchiş Z., et al., 2018).

The most important bioactive peptides determined in donkey colostrum, play an important role in various important processes that take a place at the level of the body, especially by giving it antimicrobial properties are lactoferrin, lysozyme and lactoperoxidase, being also one of the main reasons for its study (Polidori P., et al., 2022).

Compared to cow's milk, the level of lysozyme is much higher in donkey milk, also in the case of this species, is found a low content of β -lactoglobulin, casein and fatty acids (Pilla R., et al., 2010).

With regard to lysozyme, the studies showed a similar level between mature milk and colostrum (Marchiş Z., et al., 2018).

The proteins found in colostrum, are in number of 45, while at the level of milk their number is 35, they are uniquely expressed in the case of donkey (Li W., et al., 2019).

The studies conducted by Li M., et al., 2020, have determined the identification of number of 300 proteins in milk and colostrum, and 13 and 12 whey proteins are also found, which are found only in this species.

β -lactoglobulin in donkey milk and colostrum is found in the form of two different isoforms, namely the major isoform I and II, the latter being found in smaller quantities (Derdak R., et al., 2020).

Compared to cow's and goat's milk, the content of β -lactoglobulin is lower, and the α -lactalbumin, found in the form of two isoforms, with different isoelectric points, have values similar to those of human milk, thus giving milk and colostrum special nutritional qualities for use in children's diets (Derdak R., et al., 2020).

As a result of studies, it is proved that the colostrum is much richer in β -lactoglobulin and the level of lactoferrin being much higher compared to the raw milk of this species (Marchiş Z., et al., 2018).

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lactalbumin, found in the form of two isoforms, with different isoelectric points, have values similar to those of human milk, thus giving milk and colostrum special nutritional qualities for use in children's diets (Vincenzetti S., et al., 2020).

By using unguided metabolomic technology, following some studies carried out, 270 metabolites were determined in donkey colostrum, among which are uridines and thymine that have not previously been notified as metabolites of donkey milk (Li M., et al., 2020).

Due to its low content in casein, colostrum can be successfully used in treating certain health conditions, especially in people who show allergies to the milk of other species (Kocic H., et al., 2020).

The growth hormone, prolactin, insulin, glucagon and immunoglobulins in colostrum, come mainly from blood and casein, fat and lactose are produced by mammary and scent epithelial cells (Bernabucci U., et al., 2012).

In order to evaluate the physicochemical properties of donkey milk and colostrum, studies were carried out that focused on their lipid level due to the high percentage of essential fatty acids, and also the balanced proportion between the level of macro and micro elements was demonstrated, characteristics influenced by factors such as udder health, innate property in this species (Polidori P., et al., 2022).

In addition to the nutritional components that colostrum contains, it also includes various factors with anti-inflammatory action, which have the role of helping to restore cells, but also have the ability to transport after calving, the necessary immunoglobulins from mother to newborn (Marchiş Z., et al., 2018).

The anti-inflammatory action that colostrum has, can be determined by non-synthetic bioactive peptides, which also determines the possibility of its use in case of inflammatory diseases (Kocic H., et al., 2020).

All the properties and characteristics of colostrum give it the anti-inflammatory, anticancer and of course antimicrobial properties (Turini L., et al., 2020),

The laxative effect that colostrum can cause is an important factor in the elimination of meconium by newborns, and the prevention of infection after consuming it is determined by the presence of immunoproteins found in its composition (Polidori P., et al., 2022).

Both colostrum and donkey milk have immunological actions, thus being beneficial in the case of diseases related to immunity, and due to its vasodilator and antimicrobial capacity, this product can have a beneficial role in conditions such as atherosclerosis (Tafaro A., et al., 2007).

Due to their immunological capacity, donkey milk and colostrum have been evaluated in vitro, their effects on peripheral mononuclear blood cells, thus being observed the benefits brought by them through secretions induced by immunoglobulins (Amati L., et al., 2010).

Regarding the immunological response of both donkey milk and colostrum, it has been damaged that colostrum induces more immunoglobulin A and less immunoglobulin G, while milk induces the secretion of immunoglobulin G, the latter being less pronounced in this case (Tafaro A., et al., 2007).

The vasodilating capacity of colostrum is conferred by the stimulation of nitric oxide secretions, colostrum is also a stimulant for the secretions of immunoglobulin A (Derdak R., et al., 2020).

The ability to release inflammatory and anti-inflammatory cytokines, it seems to be a skill of donkey milk, colostrum is deprived of it (Tafaro A., et al., 2020).

Due to its high content in components that help in muscle formation, thanks to growth hormones and growth factors similar to insulin (somatomedin) (Utiger R.D., 2011), colostrum could be a beneficial product for performance athletes, being able to help increase endurance and burn body fat (Godhia M.L., Patel N., 2013).

Table 1

Physical and chemical properties of milk and colostrum

| | Lactoza | Protein | Fat | Urea levels | Water | pH | References |
|---|----------------------------|---|--|---|--------|----------|----------------------------|
| Compoziția colostrului și laptelui de măgăriță | 4-6 g/100 mL ⁻¹ | 10,24 g/100 mL ⁻¹ in first 6 h post partum | 3.42 g/100 mL ⁻¹ in first 6 h post partum | 51,55 mg dL ⁻¹ in first 12 h post partum | - | - | Martini M., et. al., 2020. |
| | 2,35 g/100 mL | 2,36 g/100 mL | 3,77 g/100 mL | - | 86,37% | 6,96 | Marchiș et. al., 2018 |
| | 5,8-7,4 g/100 g | 1,5-1,8 g/100g | 0,3-1,8 g/100g | - | - | 7,0-7,02 | Guo H.Y., et al., 2007 |
| | 6,93% | 1,92% | 2,91% | - | - | 7,02 | Coroian A., et al., 2020 |

IMPACT FACTORS ON THE COMPOSITION OF COLOSTRUM AND MILK IN THE DONKEY

The chemical and qualitative properties of colostrum are dependent on various factors, among which are the breed, climatic factors, the management of animal husbandry and maintenance at the farm level, and last but not least the genetic factors (Polidori P., et al., 2022).

Being a complex biological liquid, colostrum does not present a typical composition of each species, it is influenced by a multitude of factors, including the feeding of individuals and the time in which it was collected, representing, however, a very important source of macro and micro nutrients, proteins, carbohydrates, fats and many biologically active constituents (Bernabucci U., et al., 2012).

Both donkey milk and colostrum can be influenced by certain factors, including climatic variations and other environmental factors (Marchiș Z., et al., 2018).

The quality of colostrum can also be influenced by internal factors of the animal, among which are the age of the female, the state of health, the stage of lactation and of course the breed (Turini L., et al., 2020).

In particular, donkey milk and its colostrum are greatly influenced by environmental factors, especially due to the heat, the level of immunoglobulins being affected in case of high temperatures of the outside environment (Marchiș Z., et al., 2018).

Among the environmental factors with an impact on the amount of colostrum and donkey milk, the most highlighted is the heat, this species being very sensitive to heat stress, the production being diluted in case of too high temperature increase (Marchiș Z., et al., 2018).

In addition to the amount of milk, which has been determined in certain studies conducted in Italy that it is higher in the cold autumn-winter season compared to the warm season, the qualitative properties of milk and colostrum are also influenced (Marchiș Z., et al., 2018).

However, in the Amiata breed, a positive influence on the content of casein and lactose was determined during the warm season (Marchiș Z., et al., 2018).

The feeding of donkeys is an important factor both in terms of the quality and quantity of milk and colostrum obtained, as well as due to the changes that occur in the metabolic profile of individuals, the level of creatine increasing with the administration of feed with a high sugar content, while a feed with a high level of protein, leads to an increase in their muscle mass (Coroian A., et al., 2019).

In the case of donkey milk and colostrum, the proteins found are divided into three important classes, namely proteins of fat globule membranes, casein and whey protein, all of which differ and are influenced by the donkey breed and within the breed by each individual (Derdak R., et al., 2020).

Following some studies carried out on farms in Romania, on the factors that influence the composition of colostrum and donkey milk, strong correlations have been determined

between the presence of colostrum protein and lactose (Marchiş Z., et al., 2018).

It was also found that the protein level is negatively correlated with temperature, as well as the other nutritional compounds being negatively correlated with the ambient environment (Marchiş Z., et al., 2018).

Positive correlations have also been reported and determined between the relative humidity and the fat and protein content of colostrum and also between the relative humidity and lactose level in it (Marchiş Z., et al., 2018).

Another environmental factor that can influence the level of nutrients to some extent is wind speed, which has much lower influence compared to relative humidity and temperature variations (Marchiş Z., et al., 2018).

In the first week of lactation, the nutritional qualities of colostrum are strongly influenced, so changes are found on the concentration of proteins, immunoglobulins, fats and lactoferrin, so following more detailed studies, a decrease in proteins, dry matter and ashes in colostrum were observed in the first 10 days (Polidori P., et al., 2022).

The level of vitamins in the colostrum of donkeys is strongly influenced by the season, so in the cold season their level is lower compared to the warm season, a possible reason would be the factor of natural light (Vincenzetti S., et al., 2020).

Due to these changes, it was found that the colostrum phase in the case of donkeys lasts between 12-24 hours, so after this period, the secretion can be considered transitional milk (Polidori P., et al., 2022).

The stage of lactation is an important factor of modification of the denominator metabolites from colostrum and donkey milk, so that in the colostrum stage the lipid level is higher compared to their level in the mature milk stage (Li M., et al., 2020).

Also, the quality and quantity of milk and colostrum can be dependent on infection with certain larvae such as *Cylicostephanus*, the level of urea, the pH showing higher values in these cases, while the level of lactose decreases significantly (Perrucci S., et al., 2021).

But due to the high content in lysozyme of colostrum and donkey milk (Longodor A. L., et al., 2019.), and due to the udder anatomy of this species, different from other farm species (Kaskous S., Pfaffl M. W., 2022), donkeys and

their milk are less affected by bacterial diseases (Aspri M., et al., 2016).

The changes that occur during the lactation between milk and colostrum have not been studied enough so far, but it has been noted that changes in composition occur at the level of milk of this species (Derdak R., et al., 2020).

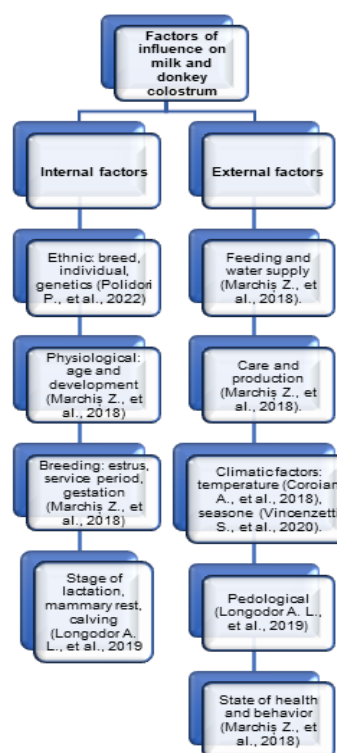


Figure 1. Factors of influence on milk and colostrum

Conclusion

Studies have shown the importance of donkey milk and colostrum, proving the importance of its consumption due to the benefits it can bring to the human body.

The chemical composition of colostrum gives important information about it, highlighting the option of using this product in the human diet and possibly in the case of performance athletes, infants and people with high sensitivity.

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