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Studies of colostrum and milk composition and quality of Gidran mares

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Abstract

Foals are born with intact but weakly functioning immune systems. Colostrum provides special immunoglobulins, which are essential for the development of passive immunity. The newborn foal is entirely dependent on antibodies from colostrum for protection against infection during the early neonatal period, meaning that after foaling, in a short time, they need to pick up a sufficient amount of colostrum in proper quality. The quantity and quality of colostrum cannot be influenced although it is well known that well-fed mares in good health typically produce enough antibody-rich colostrum for their newborn foals, the quality of colostrum can be determined by several methods. In 2022, I examined the gestation and lactation of 9 Gidran mares at Kismacs Experimental Station of Animal Husbandry of the University of Debrecen. I used a BRIX refractometer for measuring the colostrum IgG level, and a Lactoscan MCC Combo milk analyser for testing colostrum and milk.

Keywords: colostrum, immunoglobulins, foal, Gidran

Introduction

Successful breeding makes to a qualitative change. The goal is to make offspring to be better than their ancestry. Of course, this is influenced by a lot of factors, and it is a long way to go until we really know what a foal looks like. A few hours and weeks

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after foaling can be decisively influenced (NOVOTNI, 2002). In this study, we will discuss, among other things, the importance of achieving good health after foaling.
SZENCZI (2003) reported that 1 of 100 foalings require for human intervention. If there are no complications foaling is quick, but it is better to monitor the newborn from the first minutes. Adequate reproductive biology care, may reduce the risk of death or permanent damage to the foal's health.
Foals are born with an intact but weakly functioning immune system. Passive immunity in newborn foals decreases over time, as there is a process of developing active immunity. This is a temporary period when an immune deficiency state occurs, in this period foals have many difficulties. Colostrum provides special immunoglobulins, which are essential for the development of passive immunity. In the first months, almost no immune protein is produced, so their immunological functions are very weak. Mares circulation contain globulins. In the last 7-10 days of gestation, globulins take place in the mammary gland, and after that into the colostrum, this means an average of 1-2 litres of colostrum. Immunoglobulins, including immunoglobulin G (IgG), do not pass through the uterus from the mare to the fetus, foals depend on antibodies obtained from colostrum to be able to fend off pathogenic attacks. In order to assess the immune status of foals, the measurement of serum IgG is a quick, safe and obvious solution, therefore it is fundamentally decisive. In the mucous membrane of the small intestine of newborn foals there are special cells that actively and indiscriminately absorb large molecules, including immunoglobulins and bacteria through pinocytosis (KNOTTENBELT et al., 2004).
It is imperative to ensure protective immunity, so that the foal has timely access to high-quality colostrum. Serum IgG concentrations of at least 600 mg/dl are already adequate, with most foals above 800 mg/dL. Foals that do not obtain enough immunoglobulin from colostrum are considered to fail in passive transfer (FPT), with these foals having a higher risk of neonatal infection and death (McGuire et al., 1977). Thus, adequate immunity requires a serum IgG greater than 800 mg/dl, but not less than 600 mg/dl. Therefore, serum IgG between 400-800 mg/dl is called partial FPT (MORRIS et al., 1985).
The degree of absorption is significantly reduced from birth, in case of a problem it is important to intervene. A quarter of the foals born do not have access to adequate colostrum, which would protect them. Several things can cause this: the mare does not produce colostrum properly, the foal does not take it well, the absorption of colostrum from the intestines of the foal is inadequate.
The quantity and quality of colostrum cannot be influenced although it is well known that well-fed mares in good health typically produce enough antibody-rich colostrum for their newborn foals, but the quality of colostrum can be determined by several methods.
Controlling the immune status of foals is of great importance. Weak passive immunity does not necessarily immediately show symptoms, it can linger until the

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age of a few days, weeks. The health of the first days affects the subsequent performance, and thus the economic value of the foal.
My objectives were determination of IgG concentration and foal blood serum by farm methods. During my investigations, I sought answers to the following questions: whether IgG is influenced by the age of the mare, the gestation length of mare, the sex of foal. How to change: density, fat-, solids-non-fat, lactose-, and protein content of colostrum and milk during lactation.

Material and methods

In 2022, the gestation and lactation of 9 Gidran mares were examined at Kismacs Experimental Station of Animal Husbandry of the University of Debrecen. I used a BRIX refractometer for measuring the colostrum IgG level, and a Lactoscan MCC Combo milk analyser for testing colostrum and milk.
I marked the mares with G1-G9 codes. The examination of lactation lasted for 90 days. The results are the average of 2 times measured values.
I took the samples in 15 ml sampling tubes. Times of sampling: 0., 3., 6., 12., 18., 24., 36. hour, 2. day, 1. week, 1., 2., 3. month. I took a sample of at least 6 ml on one occasion, since the milk analyser machine measured with that much for sure, for the Brix refractometer it would have been enough for much less. After taking the sample, it was either tested fresh or stored frozen and thawed and measured later. I did not see any difference in the results of the two methods.
Brix refractometer shows the optical density, measures concentrations of solutes. The higher the colostrum antibody content the greater the light scattering. The scale of brix refractometer lasts from 0 to 32 %. 23 Brix% means 60 g/l IgG-concentration. High-quality colostrum can even be determined by visual inspection. Using Brix refractometer is quick and easy. Then the sample is yellowish, thick and sticky. Poor quality is white, thin, often watery.
With Lactoscan MCC Combo milk analyser we can measure fat-, solids-non-fat-, protein-, lactose content and density. The measurement went quickly with the milk analyser, as it examines a sample for 1 minute and then writes the results on the monitor.

Results and discussion

Length of gestations
According to literature, the length of gestation is 320-350 days, with an average of 336 days (BENE et al., 2013). Based on my own examination, I got a similar result. From the last fertilization average length of gestations were 335 days (Table 1.).

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Table 1. Gestation period of mares

Sample size	Mean (days)	Standard deviation	Minimum	Maximum
9	335.33	9.66	323	354

The gender of the newborns is 44.4% colt and 55.6% filly. Colts were born by 340 days and fillies were born by 331 days on average (Figure 1.).

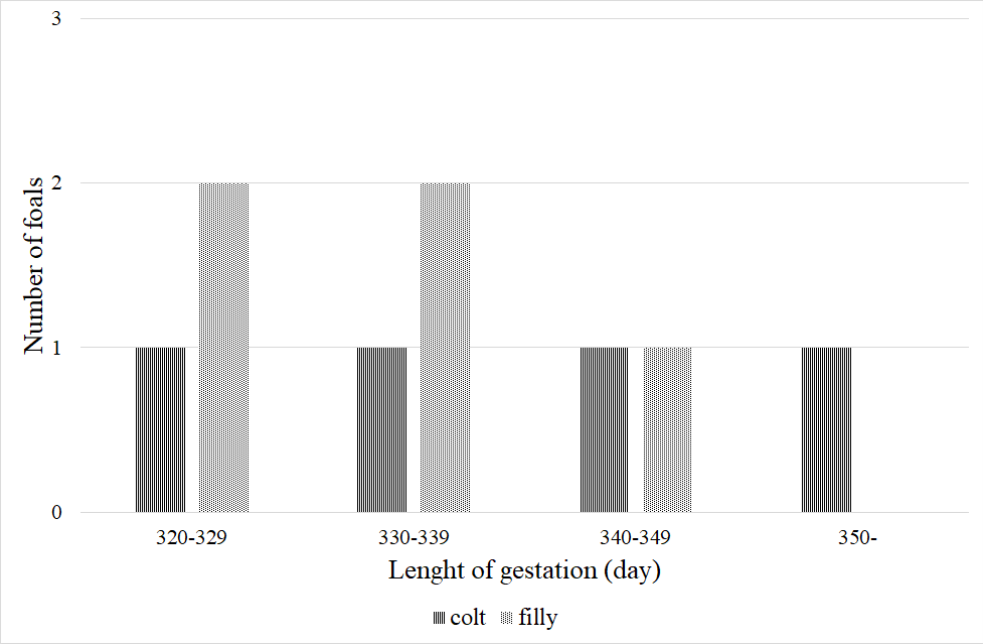

Figure 1. Gestation length and gender distribution of foals

The foals of mares fertilized in June and July foaling at 329, 331 days. Based on this, it is true that the gestation period of those fertilized between June and November is shorter. However, horses with active work tend to have a longer gestation period. However, the investigation did not prove that pre-abdominal, old mares and those that were fertilized between December and May would have a longer gestation period According to them, the gestation period can be influenced by the gender of the foal to be born and the month of fertilization.

Evaluation of colostrum by refractometer

Colostrum changes significantly by twelfth hour, by the twenty fourth hour it is transformed into milk. 23 Brix% corresponds to an IgG concentration of 60 g/l, which is already a good quality for colostrum supplementation (CHAVATTE-PALMER et al., 1998). 5 mares had colostrum above 23% (Figure 2.). G1, G3, G6,

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G8, G9 mares are also worth watching for the following foalings. If they show the same good results, it would be worth milking 200-250 ml of colostrum from them for the foals of mares with weaker colostrum. It is also worth freezing them, they can be safely used for 1-2 years. In the study, there was no correlation between the quality of the colostrum and the age of the mare, the length of gestation and the gender of the newborn.

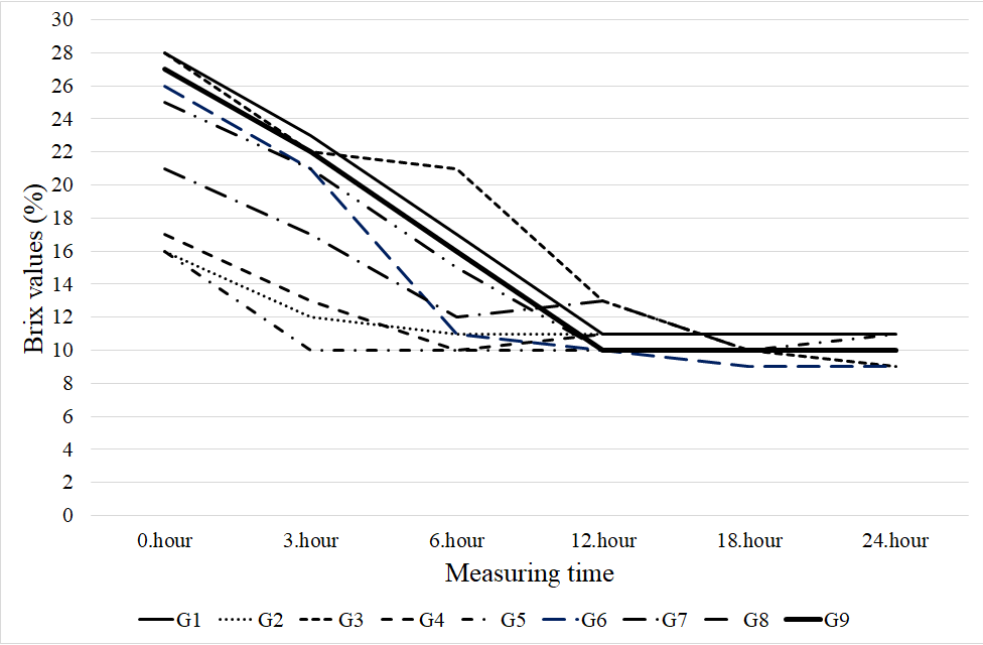

Figure 2. Brix% of colostrum after foaling

Assessment of colostrum and milk by density

The specific density of colostrum can also be used to determine its quality. Density of colostrum and milk were measured by MCC Combo Milkanalyzer. After Cash's studies (1999) 1070 kilogram/m^3 means 3000mg/dl IgG concentration. Therefore, based on this, the colostrum of G1, G3, G6, G8, G9 mares contains at least 3000mg/dl IgG concentration (Figure 3.).

The decrease continues until the 36th hour. The density of the colostrum decreased rapidly until the 12th hour (just like during the refractometer test) and from there, there was only a small change between the individual data. On average, the density of the colostrum was 1073.56 kg/m^3 in the 0th hour, which is already in the good category.

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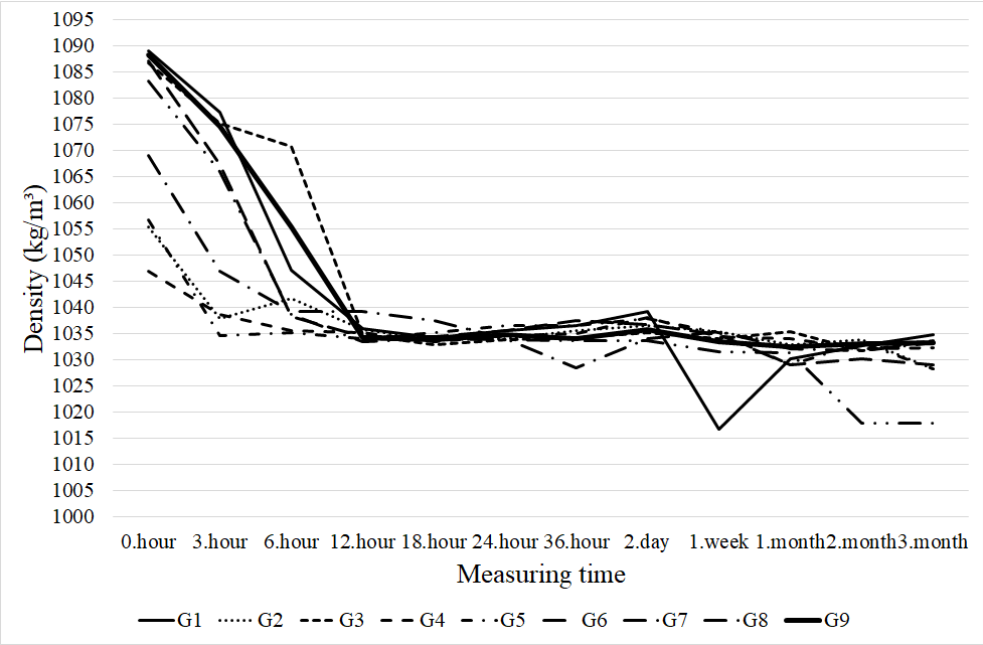

Figure 3. Changes in specific density of colostrum and milk

Fat content

There is the greatest error in sampling fat content. The fat content of mare's milk at the beginning of milking barely reaches 0,1%, at the end of milking the result can be 3-5 times, but even 10-20 times higher. The literature uses plenty of intervals because of this. There is a fact, fat content is decreased, when the energy level of feed is increased (CSAPÓ et al., 1995).

In average after foaling, the value rises, decreases in the 6th hour, and then rises again between the 12th and 24th hours. From the 36th hour to the 3rd month, the fat content of the milk continuously decreases (Figure 4.).

From the second day, the differences between individual values decreased.

Solids non-fat content

Since the Lactoscan milk analyser measures the solids non-fat content, I examined these data instead. Solids non-fat (SNF) means: protein, lactose and minerals together.

On average, the solids non-fat content immediately after foaling is 20,84%, and this value dropped spectacularly by 12th hour. We can see a small increase in the 24th and 36th hours, and from there until the end of the 3rd month, the SNF content in the milk decreases (Figure 5.).

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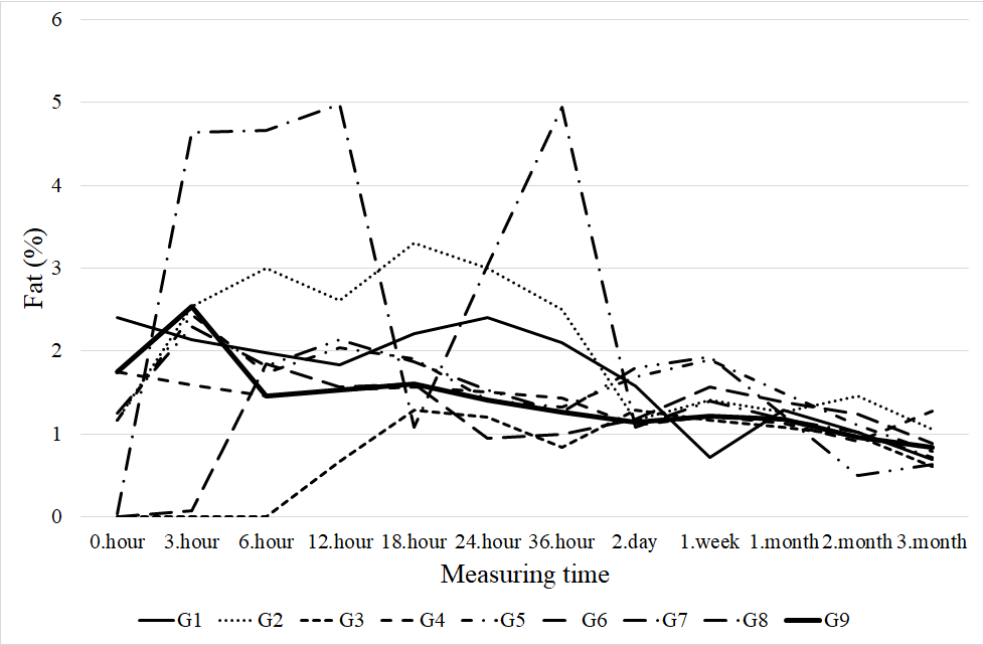

Figure 4. Changes in the fat content of colostrum and milk

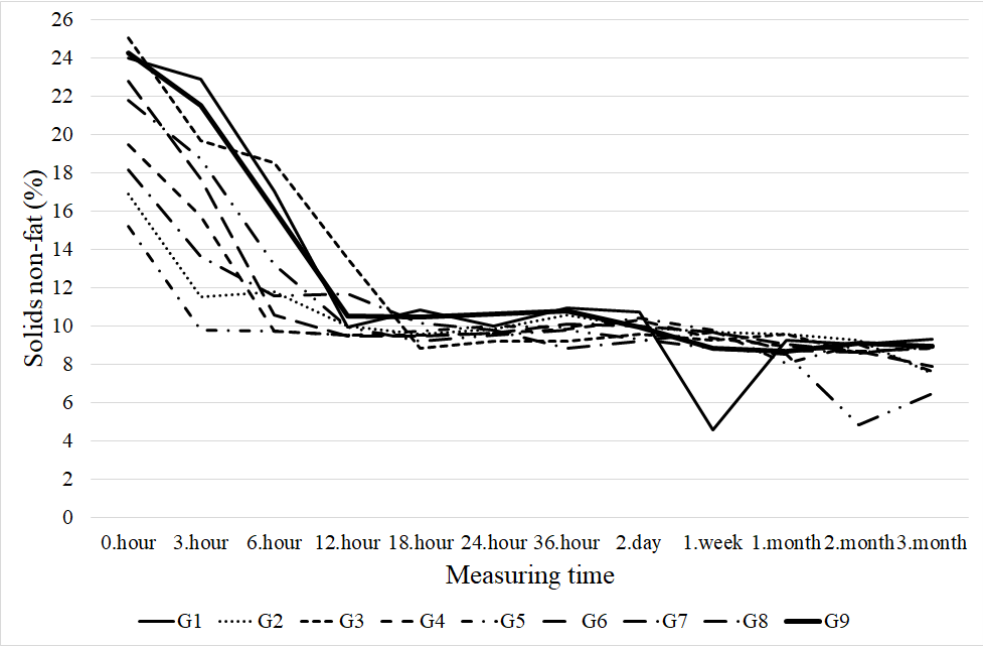

Figure 5. Changes in the solids non-fat content of colostrum and milk

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Lactose content

In the first measurements the variance of samples is high. During the study, the lactose content of the mares' colostrum varied between 6.73 -14.15% at the 0th hour (Figure 6.). It can be observed from the average values that the lactose content of milk decreases until the 36th hour, increases on the 2nd day, then decreases until the 2nd month and finally increases on the 3rd month. The biggest change can be observed up to the 24th hour. From 24th hour the values are similar, variance is low.

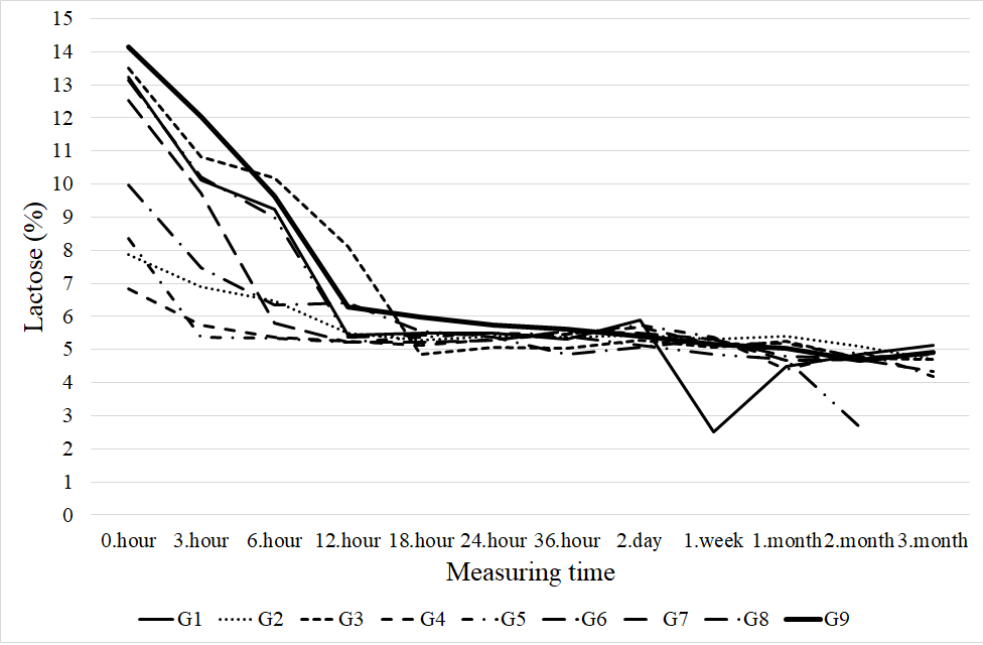

Figure 6. Changes in the lactose content of colostrum and milk

Protein content

Based on the literature, the highest protein content can be measured directly after foaling. Protein content is decreased, when the energy level of feed is increased. If mare has mastitis the protein content of milk is increased (CSAPÓ–SALAMON, 2018).

In the first measurements the variance of samples is high (Figure 7.). On average, the protein content of colostrum decreases on a large scale from hour 0 to hour 18. From eighteenth hour the values are similar, variance is low. The value increases on the 2nd day and the 3rd month.

The protein content varies in direct proportion to the lactose content and milk density (mostly this) in several mares. I did not experience any correlations between the mares.

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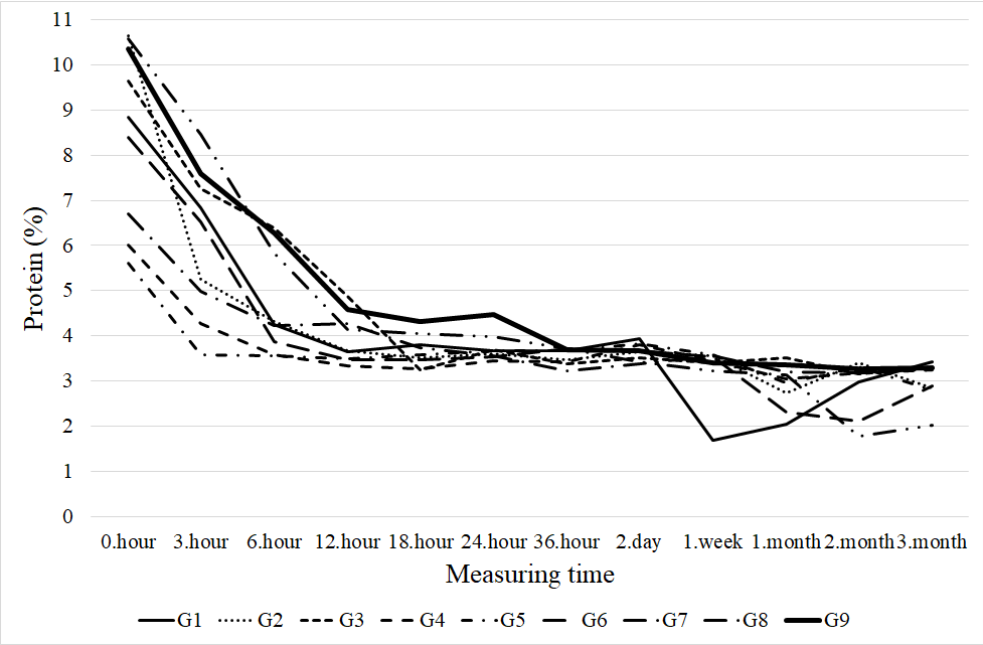

Figure 7. Changes in the protein content of colostrum and milk

Results summarized

Table 2. is made based on this experiment. The first two days contain more measurements, and the SNF was also introduced in my study. The average is moved by a prominent value in a certain direction, but the protein-lactose content and density in the aggregate table increase or decrease together.

Comparing several literatures, my values are different. Fat content is lower between 36. hour and 2. month. SNF content is lower in every measurements. Lactose content is higher to 18. hour, from 1.week is lower. Protein content is lower in 0. hour, from 1.week is lower.

Table 2. Composition of colostrum and milk of mares

Tested components	**Time after foaling**											
	hour								**week**		**month**	
	0	**3**	**6**	**12**	**18**	**24**	**36**	**48**	**1**	**1**	**2**	**3**
Density (kg/m)	1073	1058	1047	1038	1036	1035	1034	1036	1032	1032	1030	1030
Fat (%)	1.1	1.9	1.8	2.0	2.1	2.4	1.7	1.5	1.4	1.2	1.0	0.8
Non- fat-solids (%)	20.7	16.9	13.7	11.2	10.0	10.0	10.1	9.9	8.9	9.0	8.4	8.3
Lactose (%)	11.1	8.8	7.8	6.3	5.9	5.5	5.4	5.4	4.9	4.9	4.6	4.7
Protein (%)	8.3	6.2	5.0	4.2	3.8	3.8	3.6	3.6	3.3	3.0	3.0	3.0

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Conclusion and recommendation

The quality of the mare's colostrum is worth measuring with Brix refractometer, I would recommend using a colostrum replacement for foals in case of poor quality and feeding special pellet or muesli with mares. In the future, it would be worthwhile to also look at the blood serum level of the foals, supplemented with this data, a more accurate table could be prepared, in which the density, Brix% of the colostrum, the IgG concentration of the colostrum and the blood serum level of the foal are collected. This would facilitate immune status testing in field circumstances.

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