MILK FAT / PROTEIN RATIO IN KETOSIS AND ACIDOSIS

KETOSİS ve ASİDOZİSTE SÜT YAĞ/ PROTEİN ORANI

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ÖZ

GİRİŞ ve AMAÇ: Bu çalışmada İzmir ve Balıkesir yöresinde üretilen çiğ sütlerde yağ/protein oranını belirlemek amacıyla yapılmıştır.

GEREÇ VE YÖNTEM: İzmir damızlık birliğine üye işletmelerden 816 adet çiğ süt numunesi, Balıkesir damızlık birliğine üye işletmelerden 1097 adet çiğ süt numunesinin analizleri yapılarak yağ ve protein miktarları bulunmuştur.

BULGULAR: Her bir numunenin yağ miktarı protein miktarına bölünerek yağ/protein oranı hesaplanmıştır. Optimum yağ / protein oranı 1.2-1.4'tür. Düşük yağ / protein oranının nedeni subklinik rumen asidozisdir.

SONUÇ: İzmir damızlık birliğine ait çiğ sütün yağ/ protein oranı 1,1058, Balıkesir damızlık birliğine ait çiğ sütün yağ/ protein oranı 1,1035 olarak bulunmuştur.

ANAHTAR KELİMELER: Ketozis, asidozis, yağ/protein oranı

ABSTRACT

BACKGROUND and AIM: This study has been performed to determine the fat/protein ratio in raw milk produced in Izmir and Balıkesir region.

MATERIAL and METHODS: Fat and protein levels were determined after the analysis of 816 raw milk samples from member organizations Cattle Breeders Association of Izmir and 1097 raw milk samples from member organizations Cattle Breeders Association of Balıkesir.

RESULTS: Fat/protein ratio was calculated by dividing the fat content of each sample to the protein content. Optimum fat/protein ratio is 1.2-1.4. The reason of low fat/protein ratio is subclinical rumen acidosis.

CONCLUSION: Fat/protein ratio of the raw milk belonging to Izmir Breeders Association was determined as 1,1058, while the Fat/protein ratio of the raw milk belonging to Balıkesir Breeders Association was determined as 1,1035.

KEY WORDS: Ketosis, acidosis, fat to protein ratio

INTRODUCTION

The major components of milk are water, fat, protein, lactose and minerals. These components are affected by numerous factors such as genetics and nutrition. The concentration of the solid components of milk, fat and protein, are easily changed by different nutrition methods. The component most sensitive to nutrient changes that is affected most quickly is the fat concentration in the milk. Milk fat concentration may vary at levels above 3% according to nutrition. No estimations can be made depending on ration changes for lactose and mineral concentration, other solid components of milk. Apart from the high fat ration feeding method, the protein level in milk usually follows the changes in fat levels. Milk fat/proteinratio increases in ketosis, while it decreases acidosis. Fat cows have higher appetite loss compared to thin cows. Appetite loss in cows causes more delays in maximum dry matter consumption and milk production.[1]

Milk fat and protein level may give a general view of ration, nutrition, metabolic state, lactation, fertility, and the state of health. Increased energy need due to lactation cannot be met by the amount of energy received from ration feed, and it is compensated by the mobilization of body fat. Depending on the energy deficit of the animal in negative energy level, increased blood levels of non-esterified fatty acids (NEFA) resulting from the mobilization of body fat storage are transported to the liver and undergo incomplete oxidation, resulting in the formation of ketone bodies. The milk fat ratio increases when ketone bodies participate in milk formation and synthesis in mammary glands after being transported to breast tissue through blood circulation. Milk fat ratio increases in fatty liver and ketosis, and milk fat/protein ratio increases in negative energy level.

The diagnosis of ketosis is determined by checking milk fat/protein ratio at 4th week of lactation, and serum β-hydroxybutyric acid (BHBA) level at the 2nd week of lactation. Milk fat ratio is 3.67% in Holstein cows, and milk protein ratio is 2.98%. Milk fat/protein ratio is 1.23, and protein/ fat ratio is 0.81. Milk fat/protein ratio being below the level of 1.2 is a result of rumen acidosis. Furthermore, inability of rumen bacteria to multiply, insufficient energy in rumen, insufficient microbial protein synthesis in rumen and decreased level of metabolized proteins in the small intestine causes insufficient amino acid level in mammary glands due to low levels of fermentable non-structural carbohydrates in the ration feed. This causes decreases in milk protein levels.[2] Insulin concentration decreases and growth hormone increases with the start of lactation. Following the start of milk yield, glucose and metabolic energy requirement at postpartum day 21 is 2-3 times higher than prepartum day 21. Negative energy balance starts with birth. Due to low dry matter intake, glucose and metabolic energy requirement is met by hepatic glyconeogenesis, lactic acid accumulation in the liver resulting from anaerobic glycolysis in muscle tissue, glycogenic amino acids from protein catabolism, and glycerol from lipolysis in adipose tissues. Mostly, the formation of negative energy level is shown by the hormonal changes in the last period of pregnancy, the start of lactation, and decreased feed consumption. Glycogen in the liver is oxidized and body fat storage is mobilized in order to compensate for the negative energy level. When body fat storage is mobilized, free fatty acid concentration increases in plasma. This causes the presentation of fatty liver and ketosis in transition period.[3] Since the level of concentrate feed is higher than 45% in the ration of high-yield milk cows, pH level drops to 5.5-5.8 in the rumen 5-6 hours after feeding due to ruminal fermentation, and then rises again up to 6.2- 6.4. It is important to determine the ruminal pH level in the diagnosis of acidosis. Daily mean pH level should not be lower than 6.16, and ruminal pH should not be lower than 5.8 for a period longer than 5 hours in high-yield cows. It has been reported that ruminal pH levels between 5.2-5.8 suggests subacute acidosis, and pH levels below 5.2 suggests acute acidosis. Milk fat is decreased in acidosis. Ruminal bacteria release endotoxins and histamine due to decreased pH level. At that rate, it causes inflammation at the capillaries in the nail after several weeks. Saliva is a buffer material that controls ruminal pH. Increased particle size in roughage causes increased production of saliva. NDF rate should be no less than 25%, and 19% of that should be supplied from roughage for rumen to work in optimum conditions. Buffers are used in the control of ruminal pH. Sodium bicarbonate is used in 7-10 g/ kg DM, Magnesium oxide is used in 3-4 g/kg DM.[4] Feeding roughage and concentrate feed together, and having 28%-35% NDF in dry matter in the ration reduce the risk of acidosis. Feeding high-energy, easily fermentable feeds before calving in order allow some time for adaptation reduces the risk of chronic acidosis. Cows produce about 150 L of saliva in a day to control ruminal pH. The particle size of roughage has a positive effect on the secretion of saliva. Increasing the level of protein and urea in the ration causes increases in pH level.[5] Energy cannot be met physiologically due to high milk yield and decreased feed consumption at the start of lactation. An energy deficit appears in this period. This energy deficit is compensated by the mobilization of body fat, and ketosis is formed. While ketosis is generally observed in high milk yield cows at the start of lactation, when the energy level is negative for the animal; secondary ketosis is manifested as a result of decreased dry matter intake and insufficient energy from ration feeding, along with conditions that reduce appetite and limits feed consumption such as abomasal displacement, mastitis, metritis, fat cow syndrome and retained placenta (retentio secundinarium). There is a smell resembling acetone in the skin, urine, milk and breath of the animal with ketosis. Blood glucose levels fall much below normal levels in ketosis cases, and ketonemia, ketonuria and hypoglycemia are manifested. Definitive diagnosis is determined in cattle by the detection of ketone bodies in urine and milk, glucose level in blood, and ketone bodies.[6] While milk acetone level is positively correlated with milk urea nitrogen and milk fat levels, it is negatively correlated with milk protein and lactose.[7] Milk fat and protein structures show the state of nutrition.[8] While milk fat is generally increased in ketosis (≥ 4.5), milk protein (≤ 3.2) is decreased.[9, 10] Optimum milk fat / protein ratio is between 1.3- 1.5, while it is > 1.5 in cows with ketosis[11-13].

MATERIALS and METHODS

In this study, raw milk samples taken from Holstein cows from different member organizations of Izmir and Balıkesir Cattle Breeders Associations have been used. Raw milk samples from different organizations have been delivered to the laboratory with cold chain, and underwent automatic analysis with Bentleymerkim Nexgen Series Model 1 device.

RESULTS

In this study, raw milk samples taken from Holstein cows from different member organizations of Izmir and Balıkesir Cattle Breeders Associations have been used. Raw milk samples from dairy cows in different organizations have been delivered to the laboratory with cold chain, and underwent automatic analysis with Bentleymerkim Nexgen Series Model 1 device. According to the method applied by[14, 15], milk fat and protein levels have been determined for samples received in the laboratory. Descriptive statistics have been determined in IBM SPSS package program for the mean values and standard errors belonging to the milk fat/protein ratio of milk samples from Izmir (Table 1) and Balıkesir (Table 2), and results are presented below.

Table 1. *Descriptive statistics results of milk fat/ protein ratio for samples from Cattle Breeders Association of Izmir.*

	N	Min	Max	Mean	SD
Fat percent	816	2.02	5.21	3.67	0.32
Protein percent	816	2.82	4.16	3.32	0.15
Fat / protein	816	0.61	1.69	1.10	0.10

Table 2. *Descriptive statistics results of milk fat/ protein ratio for samples from Cattle Breeders Association of Balıkesir.*

	N	Min	Max	Mean	SD
Fat percent	1097	2.50	4.59	3.42	0.50
Protein percent	1097	2.32	4.73	3.12	0.25
Fat / protein	1097	0.63	1.88	1.10	0.17

DISCUSSION

In a study, mean milk fat/protein ratio has been determined as 1.147±0.186[16]. Milk fat/protein ratio below 1.15 has been stated to be a sign of ruminal acidosis[17]. Milk fat/protein ratio below 1.2 is a sign of subclinical acidosis, and it has been stated to point out the lack of structural carbohydrates (fibers, cellulose) and excess non-structural carbohydrates (starch, sugar) in the ration[18]. High number of grains in the ration, and high rate of starch and sugar, which are easily fermentable in rumen, increases the level of a fatty acid, propionic acid. However, it decreases the milk fat rate. It has been stated that decreased milk fat reduces ruminal pH as a result of overfeeding concentrated feed containing grains, and it was linked with the formation and accumulation of unsaturated long-chain trans fatty acids at low pH[19]. Trans fatty acids have been stated to hinder milk synthesis and lower milk fat[20]. High rate of roughage in the ration increases the level of a volatile fatty acid, acetic acid, and thus the milk fat rate[21]. In a study performed by Koçbeker, high rate of acidosis risk has been reported in herds with milk fat/ protein ratio below 1.2[21]. In our study performed both in Izmir and Balıkesir, milk fat/protein ratio was found to be below 1.2, and acidosis risk was determined for the herd. High risk of acidosis in these herds from two cities is a result of insufficient feeding of roughage and overfeeding of grains, particularly Dried Distillers Grain in Soluble (DDCS). Fat-to-protein ratio is a sufficient indicator for the energy level in the first stage of lactation when energy deficit arises. In another study, fat-to-protein ratio has been reported as 1.12, and Standard Deviation (SD) was 0.20[22]. Similar results have been found in our study. Fat to protein ratio and standard deviation were determined to be 1.10, 0.10 and 1.10, 0.17, respectively, in Izmir and Balıkesir cities. Optimum fat/protein ratio is 1.2-1.4. The reason of low fat/protein ratio is subclinical rumen acidosis, which affects reproduction performance negatively, and causes mineral deficiency. Furthermore, the reason of fat/protein ratio above 1.4 is subclinical ketosis, which is diagnosed with the detection of ketone bodies[18,23].

Ketosis is a highly prevalent nutritional disease seen in fresh cows after calving. Clinical findings of ketosis are extreme body condition loss, feed consumption (particularly concentrate feed), decreased milk yield, and nervous signs. Ketosis is associated with nutritional diseases such as metritis, mastitis, milk fever, lameness, and displaced abomasum which are observed commonly after calving. The strong association between ketosis and nutritional diseases demonstrate that improvements in care and nutrition will result in decreases in ketosis and nutritional diseases[24]. The cut-off value of subclinical ketosis (SCK) is 1-1.4 mmol /L blood BHBA levels[25]. The cut-off value of sub- Cows with negative energy balance meet their need for energy by mobilizing their level body fat reserves. Mobilized fat is decomposes into fatty acids and glycerol. Since glycerol is a carbohydrate, it is used in energy metabolism. Non-esterified fatty acids in the liver either turns into triglycerides with esterification or supports the energy need by oxidization. Fatty acid and ketosis is formed as a result[26].

CONCLUSION

While milk fat/protein ratio is increased in ketosis due to increased milk fat levels, resulting from the mobilization of fatty acids in the body and the participation of these fatty acids in milk production in breast tissue; milk fat/protein ratio is decreased in acidosis due to decreased ruminal acetic acid level resulting from low consumption of roughage, causing decreased milk fat levels. As a result, milk fat / protein level increases in ketosis, and milk fat/protein level decreases in acidosis. Monitoring cows according to their fat/protein level will give important hints about nutritional diseases such as ketosis and acidosis.

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