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Parameters of blood metabolites from Brown Swiss cows in production in the Puno Region. An evaluation according to the number of births

Parámetros de los metabolitos sanguíneos de vacas Brown Swiss en producción de la Región Puno. Una evaluación según el número de partos

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Abstract

Cow's milk production is an important and growing economic activity in the Puno-Peru region, with the Brown Swiss breed being the best adapted to the high plateau conditions of Peru, located above 3800 m.a.s.l. The objective of the study was to evaluate some biochemical parameters in blood serum of Brown Swiss breed cows in production based on the number of births, for which blood samples from 30 animals (10 first birth, 10 second birth and 10 third birth or more) from the district of Vilque, Puno were analyzed. Serum levels of total proteins, albumins, globulins, albumin/globulin ratio and urea (protein profile), and triglycerides and total cholesterol (lipid profile) were quantified using colorimetric-spectrophotometric techniques in the Biochemistry Laboratory of the Faculty of Veterinary Medicine of the National University of the Altiplano. The data were analyzed in a completely randomized design with InfoStat 2020e software, considering the number of deliveries as an independent variable. The results of the protein profile show an overall mean of 7.44 g dL^{-1}, 3.73 g dL^{-1}, 3.72 g dL^{-1}, 1.01 mg dL^{-1} and 31.85 mg dL^{-1} for total proteins, albumins, globulins, albumin/globulin ratio and urea, respectively ($p>0.05$); in the lipid profile they show an overall mean of 15.11 mg dL^{-1} and 150.17 mg dL^{-1} for triglycerides and total cholesterol, respectively ($p>0.05$). It is concluded that the serum levels of total proteins, albumins, globulins, albumin/globulin ratio, urea, triglycerides and total cholesterol are not influenced by the number of births of cows in production in the Puno region.

Resumen

La producción de leche de vaca es una actividad económica importante y creciente en la Región Puno-Perú, siendo la raza Brown Swiss la que mejor se adaptó a las condiciones altiplánicas del Perú, situada por encima de los 3800 m.s.n.m. El objetivo del estudio fue evaluar algunos parámetros bioquímicos en suero sanguíneo de vacas en producción de raza Brown Swiss en función al número de partos, se analizaron muestras sanguíneas de 30 animales (10 de primer parto, 10 de segundo parto y 10 de tercer parto a más) procedentes del distrito de Vilque, Puno. Se cuantificaron los niveles séricos de proteínas totales, albúminas, globulinas, relación albúmina/globulina y urea (perfil proteico), triglicéridos y colesterol total (perfil lipídico) mediante técnicas colorimétricas-espectrofotométricas en el Laboratorio de Bioquímica de la Facultad de Medicina Veterinaria de la Universidad Nacional del Altiplano. Los datos fueron analizados en un diseño completamente al azar con el software InfoStat 2020e, considerando al número de partos como variable independiente. Los resultados del perfil de proteínas con una media general de 7.44 g dL^{-1}, 3.73 g dL^{-1}, 3.72 g dL^{-1}, 1.01, y 31.85 mg dL^{-1} para proteínas totales, albúminas, globulinas, relación albúmina/globulina y urea, respectivamente ($p>0.05$), en el perfil de lípidos una media general de 15.11 mg dL^{-1} y 150.17 mg dL^{-1} para triglicéridos y colesterol total, respectivamente ($p>0.05$). Se concluye, que los niveles séricos de proteínas totales, albúminas, globulinas, relación albúmina/globulina, urea, triglicéridos y colesterol total, no son influenciados por el número de partos de las vacas en producción de la región Puno

Introduction

In the Puno department, milk production maintains an increasing trend as a result of selection, genetic improvement and feeding. However, as a consequence of this increase in production, there is also an increase in the incidence of metabolic diseases (MD), known as production diseases (PD), which leads to a slowdown in the dairy industry due to the economic losses it causes[1]. As milk production increases, physiological and nutritional conditions are altered, and it is during this transition period that the productive, reproductive, metabolic and health future of the animal is largely defined[2]. Most MD occur within the first two weeks of lactation, because the high demand for nutrients imposed on the body as a result of the increased activity of the mammary gland cannot always be met by the animal's intake, triggering a negative energy balance (NEB)[3].

A fundamental aspect in dairy production, as a consequence of the metabolic demands on high-producing cows, are MD, often exacerbated by nutritional processes that are not correctly balanced[1]. In view of this, it is very important to take care of the health, nutrition and management of dairy cows, and precisely, one of the ways to know the health status of animals is by establishing metabolic profiles, a tool that allows for the timely diagnosis of PD[4]. Fortunately, scientific and technological advances in the field of animal health and, specifically, in laboratory diagnosis, allow a series of biochemical analyses to be carried out in order to determine the health status of the animal.

In this sense, the purpose of the present study was to contribute to the establishment of the metabolic profile of the predominant dairy cattle in the Puno region based on the number of births by quantifying the serum levels of total proteins (TP), albumins (ALB), globulins (GLB), ALB/GLB ratio (A/G), urea, triglycerides (TG) and total cholesterol (CHOL) in Brown Swiss dairy cows in production of first, second and third birth or more.

Materials and methods

Location: The study was carried out at the Sutuca Farm in the district of Vilque, Puno, located at the coordinates 15° 45’ 50” S and 70° 15’ 30” W, with an average temperature of 8.4º C, an annual rainfall of 636.1 mm and at an altitude of 3950 m[5]. The biochemical analysis of the samples was carried out in the Biochemistry Laboratory of the Faculty of Veterinary Medicine and Zootechnic of the National University of Altiplano-Puno, Peru.

Figure 1 Animals of the Fundo

Animals: 30 Brown Swiss (PPC) cows were used in production with different number of births: 10 first calving, 10 second calving and 10 calvings of three or more. Only animals in apparent good health and between the second and fifth month of production were included. Animals with reproductive problems, sick animals and very old cows were excluded.

Figure 2 Blood sampling

The animals are reared in a semi-extensive manner, with rotational grazing on cultivated pastures (alfalfa and dactylis association) and on natural meadows. In the afternoon, their diet is supplemented with forage oat silage in an approximate amount of 4 kg/cow.

Blood and serum collection. Blood samples were obtained from the selected animals once only by puncturing the jugular vein using needles and vacutainer tubes without anticoagulant in a volume of approximately 5 mL while the animal was fasting. The samples were placed in a thermo-refrigerated container for transport to the laboratory, where they were centrifuged at 3000 rpm for 15 min. The serum obtained was decanted into 2 mL cryogenic vials and frozen (-20º C) until biochemical processing.

Figure 3 Animals in the grazing field

Biochemical analysis. Protein profile determinations: TP, ALB and urea and lipid profile: TG and CHOL were performed by colorimetric-spectrophotometric techniques using Wiener Lab® reagent kits: biuret technique for proteins, bromocresol green (BCG) for albumins and enzymatic techniques for urea, TG and CHOL. The GLB fraction was obtained by difference (TP-ALB) and the ALB/GLB ratio (A/G) by the ALB/GLB ratio[6].

Data analysis. A complete randomized design (CRD) was used, where the treatments were the number of births (first, second and third birth or more), reporting the means with their respective standard deviations for each biochemical parameter. The InfoStat program version 2020e was used for data processing.

Results

Serum levels of protein profile (TP, ALB, GLB, A/G ratio and urea) and lipid profile (TG and CHOL) in Brown Swiss cows according to the number of births are presented in Table 1 and 2, respectively. The analysis of variance, in both cases, indicates that there are no significant differences between the number of births for all the parameters studied-

(p>0.05).

Table 1 Protein profile in blood serum of cows according to the number of calvings

Parameter	Number of births			Overall average
	First	Second	> Third	
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	
Proteins (g/dL)	7.58 ± .43	7.42 ± .48	7.33 ± .62	7.44
Albumins (g/dL)	3.80 ± .16	3.70 ± .25	3.68 ± .23	3.73
Globulins (g/dL)	3.78 ± .44	3.72 ± .75	3.66 ± .46	3.72
A/G	1.02 ± .15	1.00 ± .10	1.02 ± .11	1.01
Urea (mg/dL)	32.46 ± 3.00	31.65 ± 2.45	31.45 ± 2.20	31.86

Table 2 Blood serum lipid profile of cows by number of calvings

Parámetro	Number of births			Overall average
	First	Second	> Third	
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	
Triglicéridos (mg dL^{-1})	15.84 ± 2.14	14.85 ± 2.29	14.65 ± 2.67	15.11
Colesterol (mg dL^{-1})	150.93 ± 18.28	151.15 ± 20.83	148.43 ± 15.34	150.17

Discussion

Protein profile. The results agree with those of Scaglione & Althaus[7] who, analyzing high-producing Holstein cows from first and third calving, did not observe significant differences in serum levels of TP, ALB, GLB, A/G ratio and urea (p>0.05). Likewise, Alberhina et al.[8], in their study carried out on lactating cows (110 to 150 days postpartum) of the Modicana breed, aged 2, 3, 4, 5 and 6 years, did not indicate statistical differences in serum levels of TP, ALB, GLB and A/G ratio for the different ages (p>0.05). On the other hand, Herrera Benavides et al.[9], also did not observe differences in serum concentrations of TP, ALB, GLB and urea (p>0.05) between heifers and cows in the last phase of lactation. Likewise, Ceballos et al.[10], did not observe differences in serum levels of TP, ALB and GLB (p>0.05) between heifers, pre-partum cows and early lactation cows. In turn, Campos et al.[11] in their study on native cows in Colombia, indicated that there are no significant differences in the concentration of TP, ALB, GLB and urea in blood serum, for cows in early lactation, late lactation and dry cows.

The concentrations of the biochemical parameters of the protein profile of the present study are within the ranges established by other authors for cattle. Thus, for proteins McCurnin[12], Kraft & Schillinger[13], Benjamin[14] and Mejer & Harvey[15], established ranges of 6.0-8.0, 6.74-7.46, 5.9-7.7 and 6.9-7.8 g dL^{-1}, respectively. The ALB are included within the range reported by Ceballos et al.[10], Meyer & Harvey[15] y Benjamin[14], who reported 2.0-5.6, 2.7-4.3, 3.0-3.8, and 3.4-4.0 g dL^{-1}, respectively. Similarly, GLB are found in the range reported by Sigua Ochoa[16] and Barrios et al.[17] of 1.86-8.38 and 2.0-6.0 g dL^{-1}, respectively. Likewise, urea levels are within the range reported for cattle by authors such as Barrios et al.[17] (13-45 mg dL^{-1}), Althaus et al.[18] (30.21-41.45 mg dL^{-1}), Meyer & Harvey[15] (21.32-55.62 mg dL^{-1} and Reece et al.[19] (20-40 mg dL^{-1}).

The mean TP found in the study (7.44 g dL^{-1}) is similar to that of Campos et al.[11] who, studying native cows from Colombia: heifers at the beginning of lac-

tation, end of lactation and dry, reported 7.26, 7.69, 7.79 and 7.82 g dL^{-1} respectively, with significant differences between heifers and the other classes. On the other hand, Scaglione & Althaus[7], in multiparous Holstein cows, reports values of 7.25, 7.41 and 7.26 g dL^{-1} for prepartum, beginning of lactation and end of lactation, respectively. Other authors report values of (7.7 g dL^{-1})[10] and (7.0 g dL^{-1})[17].

Similarly, the levels of ALB (3.73 g dL^{-1}) and GLB (3.72 g dL^{-1}) are similar to those of Scaglione & Althaus[7] for multiparous cows in the prepartum, early lactation, mid-lactation and late lactation periods: 3.77, 3.89, 3.70 and 3.89 g dL^{-1} respectively, for ALB, and 3.02, 3.16 and 3.17 g dL^{-1} for GLB. For their part, Alberghina et al.[8], in their work on lactating Modicana cows, reported values of 3.60, 3.58, 3.41, 3.40 and 3.75 g dL^{-1} for ALB, and 3.18, 3.19, 3.13, 3.14 and 3.13 g dL^{-1} for GLB for 2, 3, 4, 5 and 6 years of age, respectively, not finding significant differences between ages, such as that found in the present study.

Regarding the A/G ratio of 1.01 in the study, they differ from others. For example, Herrera Benavides et al.[9], report higher values: 1.76, in cows in the last phase of lactation; while Campos et al.[11] report lower values: 0.57, 0.82 and 0.57 for cows in early lactation, late lactation and dry cows, respectively.

Regarding the urea level of the study (31.86 mg dL^{-1}), it is similar to that found by Barrios et al.[17] who give a value of 29 mg dL^{-1} for lactating cows, but higher than that indicated by Scaglione & Althaus[7] for multiparous Holstein cows: 16.33, 23.06, 22.16 and 25.95 mg dL^{-1} in the prepartum, beginning of lactation, middle lactation and end of lactation, respectively.

Various authors indicate that the alteration of the biochemical parameters of protein metabolism is related to various metabolic alterations or damage to an organ. For example, Sigua Ochoa[16], indicates that hyperproteinemia can be caused by an increase in protein synthesis or a loss of liquid as a consequence of dehydration, vomiting and diarrhea, on the other hand, hypoproteinemia results from a decrease in protein production or from ALB losses in the case of cachexia, liver failure, nephrotic syndrome, endoparasites, maldigestion syndrome and severe burns. In the case of hypoalbuminemia, Manston et al.[20] indicate that it is due to a low protein ration in the diet or a lower hepatic ability to absorb amino acids. Reece et al.[19] states that GLB are nutritional indicators and that the liver synthesizes them whenever it has the amino acids derived from dietary nitrogen, and that a decrease in the A/G ratio is caused by a lack of adequate protein intake, which can occur in the case of fasting and malnutrition, lack of protein absorption due to severe enteritis or intestinal neoplasia.

Regarding urea, Reece et al.[19] mentions that its concentration in blood and other organic fluids varies according to the protein consumed and the ratio of protein consumed/energy metabolized from the diet, and that hyperuremia is generally interpreted as a possible renal dysfunction, due to nephritis, obstruction of the urinary tract, failure in renal circulation; on the contrary, hypouremia is a sign of a poor protein intake in the diet, as well as chronic liver failure.

Lipid profile. In the lipid profile, no influence of the number of births on the two parameters analyzed (TG and CHOL) was found. These results agree with those of Scaglione & Althaus[7], who studied high-producing first-birth and multiparous Holstein cows, and observed no differences ($p>0.05$) for the levels of both biomolecules between the lactation period or between the number of births. Similarly, Bitman et al.[21], reported values of 6.3 mg dL^{-1} of TG in lactating

Holstein cows, with no significant differences (p>0.05) between the number of births. Ayala Oseguera et al.[22], reported TG values of 13.9, 12.5 and 11.8 mg dL^{-1} in multiparous Holstein cows at 30, 60 and 90 days of lactation respectively, with no significant differences (p>0.05). Regarding CHOL, Campos et al.[11], studying seven breeds of multiparous cows at the beginning and end of lactation, reported values of 99.37 and 124.88 mg dL^{-1}, respectively, with no significant differences (p>0.05).

In the present study, a general mean of 15.11 mg dL^{-1} of TG was observed, a mean that is close to those reported by Meyer & Harvey[15] (13.48 mg dL^{-1}), Ayala Oseguera et al.[22] (13.5, 12.5 and 11.8 mg dL^{-1}. for 30, 60 and 90 days of lactation, respectively). The mean CHOL was 150.17 mg dL^{-1}, almost similar to that of Aguilar Gaivinagua[23] for cattle in the third week postpartum, 160.00 mg dL^{-1}, and, to that of Ceballos et al.[10] for cows at the end of lactation (150.79 mg dL^{-1}).

Finally, the lack of statistical difference in the biochemical parameters of the present study could be due to several factors, including: the homogeneity of the study units, the feeding and the breeding environment, in addition to the management. That is, the animals considered in the study were Brown Swiss PPC cows in production stage, from the same dairy farm. The breeding system used is semi-extensive, with a mixed diet: natural pastures, cultivated pastures and oat heme. In this regard, Wilson & Walker[6] point out that the concentration, quantity or activity of a certain cellular component present in the fluids of a healthy individual depends on many factors that can be classified into one of three categories: i) endogenous factors of the individual (age, sex, race, body condition, pregnancy, diseases, among others), ii) exogenous factors that are imposed on the individual (feeding, environment, exercise, stress, climate), and, iii) the chemical characteristics of the component. As indicated, most of these factors were controlled in the study, which is why similar values would have been obtained among all animals.

Now, the main reason why there is no statistical difference in the parameters analyzed between animals with different number of births would be that the study included animals in apparently good health; that is, the cows did not show signs of diseases associated with production; and, they were not in the transition period (30 days before and after birth). To this we must add that the production level of the farm is low (9 L/cow on average), so the metabolic demands are not as great as those of high-production animals. As Saborio-Montero[1], points out, MD usually occur in high-production animals and in the transition period, affecting the productive and reproductive performance of the animals. Thus, the animals considered in the study did not have physiological imbalances capable of causing metabolic alterations. On the other hand, it must be considered that in ruminants, most of the dietary components are fermented by microorganisms in the rumen-reticulum, whose final products constitute the main source of energy and nutrients for the host animal, as indicated by Castrillo & Balcells[24], which is reflected in the fact that the blood levels of these nutrients are within the normal ranges established by different studies in cattle. Likewise, these same authors[24] indicate that when production levels increase or are high in the animal, supplementary nutrient contributions are necessary, a fact that is not necessary in the animals studied, given their low level of production in the high plateau conditions of Peru.

It is concluded that the number of births of the Brown Swiss cow in production does not influence the pa-

rameters of the protein profile (TP, ALB, GLB, A/G ratio and urea), or the lipid profile (TG and CHOL). All concentrations are within the ranges established for the bovine species.

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The study was financed with the authors' own resources.

Conflicts of interest

The authors declare that they have no conflicts of interest with respect to the research, authorship and/or publication of this article.

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Ethical considerations

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Authors' contribution to the article

Coila Añasco Pedro Ubaldo, Velarde Ccallo Florentina, preparation, execution and editing of the article. *Hañari Quispe Renán Dilton, Aliaga Tapia Mery Luz, Ruelas Calloapaza Domingo Alberto*, study supervision.

Research limitations

There were no limitations in the present investigation.

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