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Profile of Some Haematochemical Parameters in Alpaca Housed at Three Different Altitudes

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Abstract: The aim of this study was to describe glucose, GOT, γ-GT, B-OH, GSH-PX, calcium and phosphorus concentrations in healthy Alpacas population under farming conditions. Thirty-six clinically healthy female Alpacas (*Lama pacos*) were housed in three different Chile regions (North Zone; Central Zone; South Central Zone) at three different altitudes. Blood samples were collected 4 times (Spring, Summer, Autumn, Winter) for one year period. Two-way repeated measures analysis of variance (ANOVA) were used to determine significant differences and $p<0.05$ were considered statistically significant. Bonferroni's test was applied for *post hoc* comparison.

Key words: Serum biochemical parameters, calcium, phosphorus, *Lama pacos*

INTRODUCTION

South American camelides are a critical part of the village economy of countries such as Chile, Bolivia, Peru and Argentina. However in several European countries there is an increasing interest in this specie. The fiber of their woolly coat is used in a cottage industry for manufacturing garments and other items. A lively trade at sales and shows has made them an important breeding animals as an alternative to other domestic livestock species (Fowler and Zinkl, 1989). Little information, for domesticated species of camelides, is available about many of the biochemical values commonly used to evaluate the health status of traditional livestock species (Garry, 1989).

Some research has been conduced to address nutrition, reproduction and health issues specific to these animals, but there is still a considerable amount of information needed (Robinson *et al*., 2005). Alpaca have multicompartimentalized stomach, for this reason in many time this specie was compared with cattle, sheep and goats. But a number of values are different from values for ruminants; furthermore, there are no established references ranges for a number of parameters (liver function other than enzymes and the liver-specific enzymes, kidney function, glucose tolerance, amylase, xylose absorption) (Fowler, 1998). Also the feeding behaviour and energy metabolism of these animals is not perfectly know (Trabalza Marinucci *et al*., 1999). In consideration of that the normal values for clinical blood parameters should be described with respect to age, sex, breed and physiologic conditions of the subjects and also with respect to climatologic factors (Yokus and Cakir, 2006); the aim of this study was to describe glucose, GOT, γ-GT, B-OH, GSH-PX, calcium and phosphorus concentrations in healthy Alpacas population under farming conditions. Differences due to seasons (Spring, Summer, Autumn, Winter) and environmental condition were studied to obtain reference values for this species.

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MATERIALS AND METHODS

Thirty-six clinically healthy female alpacas (Huacaya breed), aged between 3 and 5 years, were used in the study that was carried out from March 2004 to December 2004, in three different Chile's regions: North Zone (group A): The comuna General Lagos is located in the Altiplanic Andean of the first region of Tarapacá, county of Parinacota (Latitude 17° 00'/18° 00 and Longitude 69° 00'/70° 30'). The property is located to 3 km from Visviri to a superior altitude to the 4,000 m above sea level and it presents a near surface to the 4000 ha. The main characteristics of the highland are the drops temperatures, the intense solar radiation and the atmospheric pressure 40% inferior to the value that is presented at sea level. Mean annual temperature was -0.8°C (max 7,1°C, min -5.6), with RH% between 52 and 56% and daily mean value between 61 and 87% in Summer and between 41 and 67% in other annual periods. They present near values to the 400 mm a year with low relative humidity. Center zone (group B): located in the seventh region of the Maule, Chile. The property is located in the Quenehuao ranch (latitude 35° 35' S; longitude 72° 16' W), to 10 km of the urban center of Empedrado with address to the south, in route to the town of Sauzal, to an altitude of 80 m above sea level and it presents a near surface to the 2000 ha. The feeding of the animals is based on shepherding. It is also important to consider that these fields are shared with sheep and wild animals of the sector. The thermal oscillation is unequal with values that they fluctuate between the less 5°C and the 38°C with a rainfall among 500-800 mm of water a year. South center zone (group C): located in the ninth region of the Araucanía. The property is located in the flock Llamas del Sur, in the comuna Padre de Las Casas km 15 in route to Cunco, in the proximities of the city of Temuco (latitude 38° 43' S; longitude 72° 34' W), to an altitude of 150 m above sea level a near surface to the 90 ha. The used prairies are of trefoil-ballica with handling in areas of 1 to 5 ha. The density is of 7 animals for hectare and the alpacas share the shepherding areas with llamas and wild animals of the area. The temperatures in this area present moderate widths between the day and the night reaching values between 5 and 25°C along the year with registrations annual means of almost 12°C.

In each farm 12 animals (10% of all subjects) were randomly chosen. Before the start of the study, all the subjects underwent a heart exam, respiratory auscultations and routine haematology and plasma biochemistry at rest. Only clinically healthy animals were used. On each subject blood samples were collected 4 times a year (Spring, Summer, Autumn, Winter). Blood samples were collected through an external jugular venipuncture using vacutainer tubes (Terumo Corporation, Japan) with EDTA to assess glucose by means of Blood Glucose Meter (Glucotrend 2, Roche); blood samples, collected using vacutainer with no additive, were centrifuged at 3000 x g for 10 min. On the obtained serum, stored at -20°C pending analysis, AST (Aspartate aminotransferase), γ-GT (Gamma-glutamyl transpeptidase), B-OH (beta-hydroxybutyrate), GSH-PX (glutathione peroxidase), calcium and phosporus were assessed by means of means UV spectrophotometry (Microlab 200, Merk). Two-way repeated measures analysis of variance (ANOVA) were used to determine significant differences and $p<0.05$ were considered statistically significant. Bonferroni's test was applied for *post hoc* comparison.

RESULTS

The highest glucose values were observed in group A during Spring, Summer and Winter periods and in Group B during Autumn period. The highest AST values were observed in group A during Spring period, in Group B during Summer and Autumn period and in Group C during Winter period. The highest γ-GT and B-OH values were observed in group A in all four periods. The highest GSH-PX values were observed in group C during Spring and Summer periods and in group B during Autumn

and Winter periods. The highest calcium values were observed in group A during Spring and Autumn periods, in group B during Summer and Winter periods. The highest phosphorus values were observed in group A during Spring, Summer and Autumn periods, in group B during Winter period.

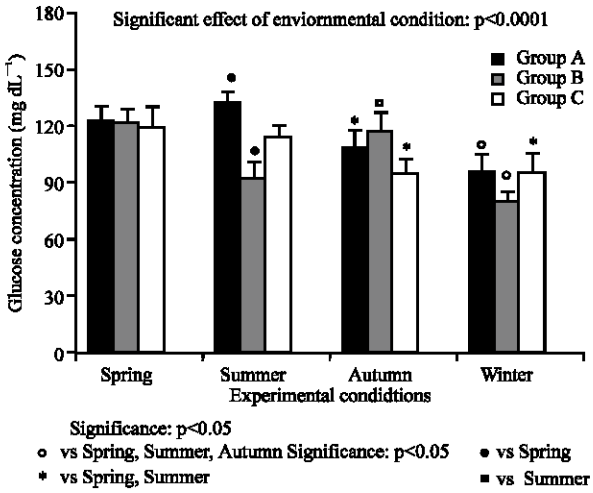

Fig. 1: Glucose concentrations (mean±SD) together with the relative statistical significance monitoring during different seasonal period, in Alpacas farmed at three different altitudes: 400 (group A), 80 (group B) and 150 (group C) meters above sea level (p<0.0001), during a year period

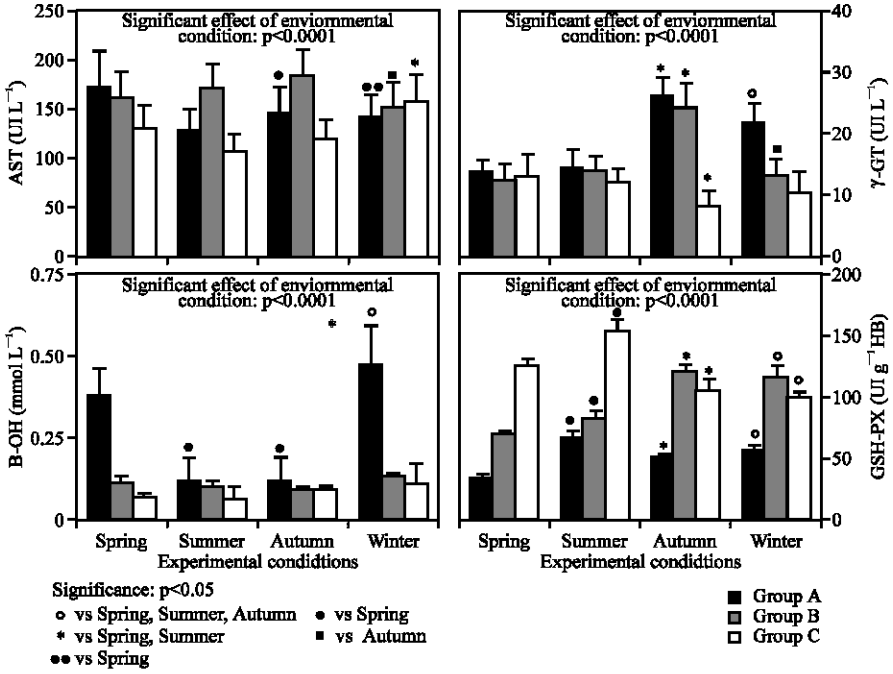

Fig. 2: The pattern of mean value and the standard deviations together with the relative statistical significance of AST (UI L^{-1}), γ-GT ((UI L^{-1}), B-OH (nmol L^{-1}) and GSH-PX (UI g^{-1} Hb) recorded in Alpacas farmed at three different altitudes: 4000 (group A), 80 (group B) and 150 (group C) meters above sea level (p<0.0001), during a year period

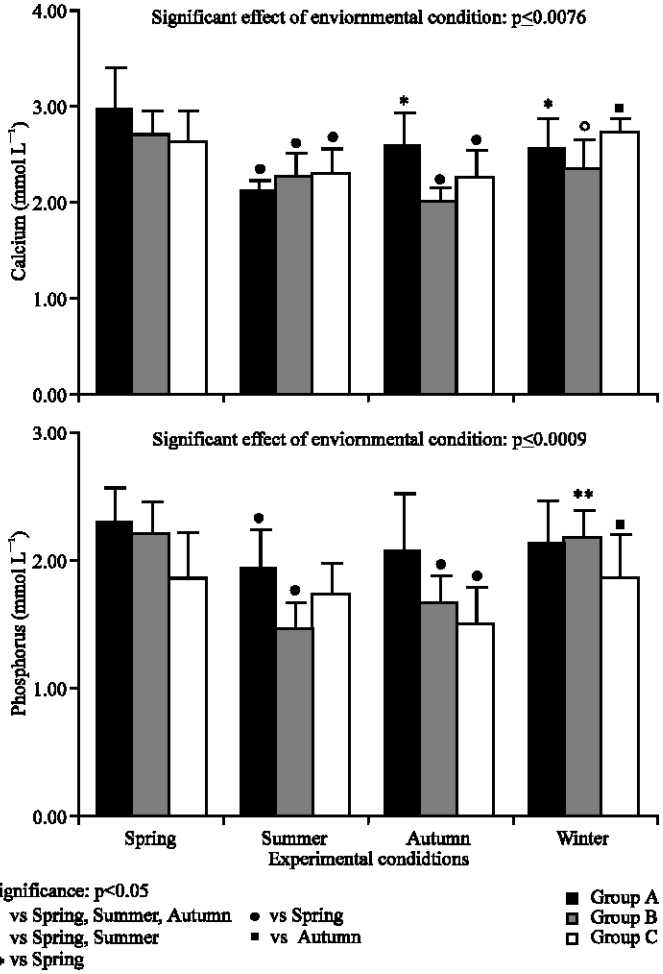

Fig. 3: The pattern of mean value and the standard deviations together with the relative statistical significance of Calcium (mmol L^{-1}) and Phosphorus (mmol L^{-1}) recorded in Alpacas formed at three different altitudes: 4000 (group A), 80 (group B) and 150 (group C) meters above sea level ($p \leq 0.0076$ and $p \leq 0.0009$, respectively), during a year period

ANOVA showed a highly significant effect of environmental condition on all studied parameters as follow: glucose ($F_{(3,99)} = 27.51$; $p<0.0001$), AST ($F_{(3,99)} = 25.93$; $p<0.0001$), γ-GT ($F_{(3,99)} = 93.45$; $p<0.0001$), B-OH ($F_{(3,99)} = 101.86$; $p<0.0001$), GSH-PX ($F_{(3,99)} = 1711.32$; $p<0.0001$), Calcium ($F_{(3,99)} = 5.68$; $p \leq 0.0076$) and phosphorus ($F_{(3,99)} = = 8.79$; $p \leq 0.0009$). Also ANOVA showed a highly significant effect of annual period on all studied parameters as follow: glucose ($F_{(3,99)} = 75.50$; $p<0.0001$), AST ($F_{(3,99)} = 3.80$; $p \leq 0.0126$), γ-GT ($F_{(3,99)} = 33.65$; $p<0.0001$), B-OH ($F_{(3,99)} = 55.60$; $p<0.0001$), GSH-PX ($F_{(3,99)} = 104.97$; $p<0.0001$), Calcium ($F_{(3,99)} = 33.08$; $p<0.0001$) and phosphorus ($F_{(3,99)} = 23.98$; $p<0.0001$) (Fig. 1-3).

DISCUSSION

One of the big problems facing the clinical chemist and clinician is the definition of the so-called normal profile. Since by definition the decision of abnormal value is depending on it. Since genetics,

physiology, nutrition and environmental conditions are influencing the clinical pathology profiles, it is necessary to establish these normal reference values, for each animal species, under defined environmental and nutritional conditions according to age, sex and physiological conditions (Bogin, 2000).

Glucose values found in Alpacas were similar to values reported for llamas and higher than in ruminants (Fowler and Zinkl, 1989). Higher blood glucose concentrations relative to other ruminants may be due to insulin resistance or the camelids inability to shift their metabolism from fats to carbohydrates (Cebra *et al*., 2001). Plasma glucose is unaffected by the diet (Davies *et al*., 2006), therefore we can assume that glucose modification during a year period and the statistical significant difference between the groups were probably due to environmental influence on carbohydrates metabolism; seasonal variations in glucose concentrations also have been reported in cattle and a lower glucose concentration was observed in cows housed in moderate high altitude in comparison with cow housed at sea level (German *et al*., 1992).

Present results about AST, γ-GT and B-OH, could be considered as reference values, therefore there aren't reference values for these parameters in camelides.

GSH-PX is believed to play an important role in cellular antioxidant defence by reducing hydrogen peroxide and various hydroperoxides using glutathione as a reducing agent to form water and corresponding alcohols, respectively; it is a selenium-containing protein present in both cytosol and mitochondria of eukaryotic cells (Zarowski and Tappel, 1978; Epp *et al*., 1983; Tappel, 1984; Timcenko-Youssef *et al*., 1985). Since GSH-PX is believed to be a key antioxidant enzyme, its physiological relevance has previously been implicated from studies on animals fed with selenium-deficient diet (Ho *et al*., 1997). GSH-PX values found during this study are substantially similar than those reported for female Alpacas (Morgante *et al*., 1999). GSH-PX shows statistical significant modification during all experimental period, with a significant statistical influence of the environmental conditions. Probably there were significant interaction between dietary Se and protein on GSH-PX; under Selenium deficiency condition and low level of protein may decrease GSH-PX utilization and increase GSH-PX synthesis (Zhu *et al*., 1993). While calcium statistical significant modifications were probably due to the weather and forage as previously observed for the cow (Marsh *et al*., 1959; Stufflebean *et al*., 1964).

Serum inorganic phosphorus values show a wide range of reported normal, particularly at the lower end of the scale. Some authors believe that those low values do not represent a true normal range because it his now known that hypophosphtemia in a common clinical finding in llamas and alpacas during long period of inclement weather when animals are deprivated of exposure to sunlight. Phosphorus levels below 4.5 mg dL^{-1} (1.35 mmol L^{-1}) should be considered hypophosphatemic (Fowler, 1998). Present phosphorus values are higher than 1.35 mmol L^{-1} and could be considered as references values.

Furthermore too little information is available to draw conclusions relative to metabolic profile in Alpacas; therefore the values presented in this study can serve as reference values for Alpacas farmed at different altitudes.

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