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Study of effect of age, sex and physiological stages on minerals and electrolytes balance in Mehsana Goat (*Capra hircus*)

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Abstract

The aim of this study was to determine effect of age, sex and physiological stages on mineral and electrolyte balance in Mehsana goat. 42 number of clinically healthy Mehsana goats were divided into seven groups with 6 number of animal per group: T₁ (male kids <1 year), T₂ (bucks >1 year), T₃ (female kids <1 year), T₄ (pregnant lactating does), T₅ (non-pregnant lactating does), T₆ (pregnant dry does), and T₇ (non-pregnant dry does). Blood samples were collected from each animal for separation of serum samples to determine the minerals and electrolyte concentration employing different methods with help of Clinical Analyzer. The obtained data analyzed using standard statistical procedures. Mean values for minerals and electrolytes (Ca⁺⁺, Mg⁺⁺, Pi, Na⁺, K⁺, Cl⁻) were obtained and compared within animals of different experimental groups. The bucks had significantly ($p \leq 0.05$) higher concentration of Mg²⁺ than kids. Conversely, Ca²⁺ and K⁺ concentration were significantly ($p \leq 0.05$) lower in bucks than kids. Pregnant does had significantly ($p \leq 0.05$) higher values of Ca²⁺ than that of non-pregnant does. The concentration of Pi was non-significantly higher in male kids than female kids. Cl⁻ concentration was significantly ($p \leq 0.05$) higher in does as compared to that of female kids. Ca²⁺ and K⁺ concentration was significantly ($p \leq 0.05$) higher in pregnant does than non-pregnant does, while reverse was true for Na⁺. The baseline values for different minerals and electrolytes obtained, which would be further helpful in future for realistic disease diagnostic and animal welfare programme.

Keywords: mehsana, goat, minerals, electrolytes

Introduction

Among the small ruminants, goat is one that is in high demand for meat, milk and ritual sacrifices (Bourn *et al.*, 1994) [6]. Goats are known for their tolerance power as they survive in most harsh environments. Goats were domesticated in the Indian subcontinent by 9000 B.C.E. (Gupta and Anil, 2004) [14]. Goat rearing is a traditional occupation of small, marginal farmers and landless laborers in semiarid, arid, hilly and mountain regions of India, inhospitable to conventional crop cultivation. They produce food and fiber at relatively low cost from feed materials from land that often cannot be used for conventional crop production. There are total 570 goat breeds in the world (Devendra and Liang, 2012) [8]. Total goat population in the world is estimated as about 1005.60 million. India holds 1st rank in goat population of the world (FAOSTAT, 2013) [10]. Goat population of Gujarat state is about 46.40 lakhs contributing 19.72% of total livestock (Bulletin of Animal husbandry and Dairying Statistics, Gujarat, 2011-2012). Mehsana is the most popular breed in North Gujarat because of its prolificacy and adaptability to the arid and semi- arid climatic conditions (Aggarwal *et al.*, 2007) [1].

The electrolytes and minerals are mainly affected by nutrition, age, sex, genetics, reproductive status, housing, starvation, environmental factors, stress and transportation (Balikci *et al.*, 2007) [3]. Amongst the biochemical analytes, minerals play significant role since these are the main part of the many tissues constituents, activate enzymes, are essential co-factors of metabolic reactions and play a vital role in resistance, adaptation and evolution of new breeds and strains. Determination of "normal values" for minerals and electrolytes thus become imperative for any disease monitoring programme as it forms the very basis for clinical interpretation of laboratory data (Zvorc *et al.*, 2006) [26].

In view of these, the present study was undertaken to determine the baseline values of minerals and electrolytes of clinically healthy Mehsana goat as well as to study the influence of age, sex, gestation, lactation and dry stage.

Materials and Methods

Place of study

The present investigation was carried out from the month of August to December 2014 in the Sardarkrushinagar Dantiwada Agricultural University (SDAU), Gujarat on Mehsana Goats, maintained at the Livestock Research Station (LRS), SDAU. Geographically LRS (Livestock research station) of SDAU is located 23.33⁰ to 24.45⁰ north latitude and 71.03⁰ to 73.02⁰ east longitude at an elevation of 215.285 meters above the mean sea level. The climate of area is tropical and semi-arid.

Selection of experimental animals

A total of 42 (12 males and 30 females) clinically healthy Mehsana goats from LRS, were randomly selected and divided into seven groups with 6 number of animal per group: T₁ (male kids <1 year), T₂ (bucks >1 year), T₃ (female kids <1 year), T₄ (pregnant lactating does), T₅ (non-pregnant lactating does), T₆ (pregnant dry does), and T₇ (non-pregnant dry does). The goats were reared under standard feeding and management practices. All the animals were given anthelmintics prior to study. The health status of animals was regularly evaluated.

Collection of serum samples & analysis

The 8 ml blood was collected to VACUETTE[®] Z Serum Clot Activator tubes and kept in slanting position for about 1 hour followed by centrifugation at 700xg for 15 minute to harvest the serum. After centrifugation, clear serum samples were

collected in sterile screw tubes of 5 ml capacity. The separated serum samples were properly labeled and stored at -20°C till further analysis.

Minerals and electrolyte analysis

Serum samples were analyzed for different minerals (Ca⁺⁺, Mg⁺⁺, P_i) and electrolytes (Na⁺, K⁺, Cl⁻) using respective kits by Clinical Analyzer-635 (Systronics, India Ltd., India). Calcium (Ca⁺⁺) was estimated by the method described by Faulker *et al.* (1973) [12]. Magnesium (Mg⁺⁺) was estimated by employing the method of Farrel (1984) [11] and Young (2001) [25]. Inorganic phosphorus (P_i) was estimated by method described by Tietz (1983) [22]. Sodium (Na⁺) was estimated by Mono Test (Henry, 1974) [15]. Potassium (K⁺) was estimated by the method described by Henry (1974) [15]. Chlorine (Cl⁻) was measured by the method described by Doumas *et al.* (1971) [9].

Statistical Analysis

Data collected were analyzed using analysis of variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (Gomez and Gomez, 1983) [13]. Statistical Analysis Software (SAS, 1999) [20] computer package was used. p < 0.05 was considered to be statistically significant.

Results

The results for Ca⁺⁺, Mg⁺⁺, P_i, Na⁺, K⁺ and Cl⁻ were documented in Table 1.

Table 1: Concentration of minerals and electrolytes of different experimental groups of Mehsana goats

Parameters	Groups	Male Goats Group I		Female Goats Group II				
		T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Calcium (Ca ²⁺) (mg/dl)		7.12±0.09 ^b	6.48±0.08 ^a	7.13±0.08 ^b	11.38±0.18 ^c	9.23±0.20 ^c	10.91±0.29 ^d	9.02±0.08 ^c
Magnesium (Mg ²⁺) (mg/dl)		2.06±0.05 ^a	3.11±0.15 ^b	1.94±0.06 ^a	3.64±0.14 ^c	2.91±0.13 ^b	3.28±0.18 ^{bc}	2.91±0.14 ^b
Inorganic phosphorus (P _i) (mg/dl)		2.64±0.09 ^b	2.62±0.12 ^{ab}	2.41±0.09 ^{ab}	2.59±0.11 ^{ab}	2.59±0.08 ^{ab}	2.33±0.04 ^a	2.51±0.10 ^{ab}
Sodium (Na ⁺) (mEq/L)		155.28±4.87 ^{ab}	163.20±5.40 ^b	151.61±3.20 ^{ab}	141.15±3.51 ^a	144.17±3.58 ^a	151.11±6.93 ^{ab}	162.16±3.03 ^b
Potassium (K ⁺) (mEq/L)		5.59±0.09 ^b	4.54±0.11 ^a	5.48±0.09 ^b	5.53±0.10 ^b	4.51±0.09 ^a	5.58±0.08 ^b	4.64±0.13 ^a
Chloride (Cl ⁻) (mEq/L)		91.62±3.49 ^{ab}	88.81±1.14 ^a	91.56±3.58 ^{ab}	104.86±0.58 ^c	95.07±0.98 ^{ab}	98.52±1.20 ^{bc}	98.44±2.26 ^{bc}

a, b, c, d, e: Means along the same row with any identical superscripts are not significant (P>0.05). No of Observation (6)

(Where: T₁ - Male Kids, T₂ - Bucks, T₃ - Female Kids, T₄ - Lactating pregnant does, T₅ - Lactating non-pregnant does, T₆ - Dry pregnant does and T₇- Dry non-pregnant does)

The mean ± S.E. values (mg/dl) of Ca²⁺ ranged from 6.48 ± 0.08 to 11.38 ± 0.18 among all the experimental groups of Mehsana goats. The Ca²⁺ levels in pregnant does were significantly (p ≤ 0.05) higher than that of the non-pregnant does. The Ca²⁺ levels of male and female kids were found to be almost similar but the bucks had significantly (p ≤ 0.05) lower value than the kids.

The level of Mg⁺⁺ ranged from 1.94 ± 0.06 to 3.64 ± 0.14 among all the experimental groups of Mehsana goats. The serum Mg²⁺ level was found to be almost similar in kids but elevated (p ≤ 0.05) significantly in bucks. It was further noticed that amongst adult female goats, the lactating pregnant does had significantly (p ≤ 0.05) higher concentration of serum Mg²⁺ than the dry non-pregnant does.

The level of (inorganic phosphorous) P_i ranged from 2.33 ± 0.04 to 2.64 ± 0.09 among all the experimental groups of Mehsana goats. It was found that male kids had apparently higher P_i levels than that of the female kids. Further, non-significant variation was observed among lactating and dry does. The P_i levels in pregnant and non-pregnant groups of does also not varied significantly.

The level of Na⁺ (mEq/L) ranged from 141.15 ± 3.51 to 163.20 ± 5.40 among all the experimental groups of Mehsana goats. No significant difference was recorded between male and female kids while, bucks had non-significantly higher values of Na⁺ than kids. However, significantly (p ≤ 0.05) higher Na⁺ value was recorded for dry non-pregnant does than lactating pregnant and lactating non-pregnant does.

The level of K⁺ (mEq/L) ranged from 4.51 ± 0.09 to 5.59 ± 0.09 among all the experimental groups of Mehsana goats. It was found that the K⁺ levels did not differ significantly among male and female kids whereas; bucks had significantly (p ≤ 0.05) lower K⁺ level than the male kids. Moreover, K⁺ levels were significantly (p ≤ 0.05) higher in pregnant does than non-pregnant does.

The level of Cl⁻ (mEq/L) ranged from 89.81 ± 1.14 to 98.52 ± 1.20 among all the experimental groups of Mehsana goats. Statistical analysis revealed that there was no significant difference among groups of kids and bucks. The concentration of Cl⁻ also didn't vary among different groups of does.

Discussion

There was no significant variation of Ca^{2+} levels between male and female kids which was in line with the findings of Bhat *et al.* (2011) [5]. However, the bucks had significantly ($p \leq 0.05$) lower value of serum Ca^{2+} than kids which was in contrast with the research findings of Bhat *et al.* (2011) [5]. Similarly, the Ca^{2+} levels in pregnant goats were significantly higher than that of non-pregnant does which was in agreement with the research findings of Waziri *et al.* (2010) [23]. Yadav *et al.* (2002) [24] observed that the concentration of Ca^{2+} increased with advancement of age of indigenous Andaman goats under hot and humid climate. The concentration of Ca^{2+} was higher in males of 6-12 months of age compared to females of the same age group (Mohanasundari *et al.*, 2003) [17].

The Mg^{2+} level was non-significantly higher in male kids than that of female kids. The bucks and adult females had non-significantly higher levels of Mg^{2+} than that of male and female kids. However there was also non-significant variation among dry and pregnant does. So, as seen that Mg^{2+} levels showed variation among the different physiological states which is in agreement with Kadzere *et al.* (1997) [16], Ahmed *et al.* (2000) [2] who observed that level of Mg^{2+} increased some times and decreased other times in relation to different stages of pregnancy and lactation, also Pinar (2009) [19] who found that Mg^{2+} level decreased after parturition.

It was revealed that male kids had no significantly higher inorganic phosphorus levels than that of female kids which was in contrast with the findings of Bhat *et al.* (2011) [5]. Further, non-significant variation was observed among lactating and dry goats which was in agreement with the research findings of Bamerny (2013) [4]. The Pi values of pregnant and non-pregnant groups of goats apparently differed, but the difference was statistically non-significant which was in line with the research findings of Bamerny (2013) [4]. Shaikat *et al.* (2013) [21] found that Pi levels were highest in Jamnapari than Black Bengal goats.

No significant difference was recorded between male and female kids. However, bucks had non-significantly higher values of Na^+ than that of the kids which was in agreement with the values reported by Bhat *et al.* (2011) [5]. There was no significant variation of Na^+ levels among adult female groups i.e. lactating pregnant, lactating non-pregnant, dry pregnant and dry non-pregnant does which was in line with the research findings of Bamerny (2013) [4].

It was found that the potassium levels did not differ significantly among male and female kids which was in agreement with the research findings of Bhat *et al.* (2011) [5], but, bucks had significantly ($p \leq 0.05$) lower potassium level than the male kids which was in line with the values reported by Bhat *et al.* (2011) [5].

Although, no significant difference was observed among chloride values of bucks and male kids, similarly male and female kids also showed non-significant variation which was in agreement with the research findings of Piccione *et al.* (2010) [18].

Conclusion

The results of the present study demonstrate the normal concentration of minerals and electrolytes of Mehsana goat at different physiological stages. Present results stated some significant variation of parameters among groups whereas some shows no significant variation at all. However, further investigation is required to verify the values depending on season and other climatic conditions.

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