

CALCIUM AND PHOSPHORUS CONCENTRATION IN FEEDSTUFFS AND BLOOD OF SMALL RUMINANTS OF THAL IRRIGATED AND DERA GHAZI KHAN IRRIGATED AREAS OF PUNJAB, PAKISTAN

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ABSTRACT

Calcium and Phosphorus status of feedstuffs and blood plasma of sheep and goats in Thal Canal Irrigated and Dera Ghazi Khan Irrigated areas of Punjab, Pakistan was determined during summer and winter season. The samples were taken from five different sites which were selected on the basis of sheep and goats population and feedstuffs availability and analyzed for Ca and P by Atomic Absorption Spectrophotometer and Spectrophotometer. Rice grain and wheat grain showed significant ($P<0.05$) for Ca level whereas millet grain and wheat grain showed significant ($P<0.05$) difference for P level. Comparatively significant ($P<0.05$) difference was observed for sheep and goats between Thal Canal Irrigated zone and D. G. Khan Irrigated zone.

Key words: Soil, Water, feedstuffs, blood plasma, Atomic absorption spectrophotometer

INTRODUCTION

In spite of large population and production potentials of sheep and goat Punjab, Pakistan there are lot of constrains i.e. proper management, nutrition and importantly the minerals deficiencies to achieve their peak productive and reproductive performance. The minerals become more important, as the small ruminants are mainly fed on grazing without any proper feed and mineral supplementation and the only source of minerals for them are the grasses and forages. The availability and concentration of minerals in crop and forages are influenced by environmental factors such as climate and seasonal conditions during the growth, amount of rainfall, type and soil fertility, stage of maturity, genus and the species of the forages (Underwood and Suttle, 1999). It is important to determine the mineral profile based on animal fluid/tissue concentrations in order to estimate the mineral needs of grazing ruminants, as well as the time of the year when they are most needed (Khan *et al.*, 2005). The present study was conducted to compare the calcium and phosphorus status of water, soil, different feedstuffs and blood plasma of two zones of Punjab i.e. Thal Irrigated and Dera Ghazi (D. G) Khan.

MATERIAL AND METHODS

Investigation Area: Five different sites were selected for sample collection from Thal Irrigated Canal zone (Khaliqabad, Quaidabad, Mitha tiwana, Roda and Hamok) and D. G. Khan Irrigated zone are (Khar Gharbi, Muradabad, Shahjamal, Bet Mir Hazar and Chandarban) based on livestock population and roughages and concentrates availability for sampling twice a year (in winter and summer seasons). Three representatives samples (0.5-1 kg on dry matter basis) of feedstuffs like barseem, millet grain, rice grain, sugar cane top, toria fodder, wheat bran, wheat grain and wheat straw were collected from each site (3 representative samples \times 8 feedstuff \times 2 seasons \times 5 sites = 240 total samples) (Singh *et al.*, 2005) and dried for further analyses (AOAC, 2000). Jugular vein was punctured to collect 10 ml of blood in a heparin coated vacutainer tubes (Vacutainer, Becton Dickinson, Franklin Lakes, NJ) and plasma was harvested for freezing (-20°C) till analyses (Awan and Awan, 2001). The plasma was diluted as such for Ca analysis on atomic absorption spectrometer (Perkin-Elmer, AA400) while the P was analyzed by spectrophotometer (Singh *et al.*, 2005). After wet digestion of the feed / forage and as such dilution of blood plasma samples, Ca and P were estimated by atomic absorption spectrophotometer (Perkin-Elmer, AA 400) and spectrophotometer (Singh *et al.*, 2005).

Statistical Analyses: The obtained data was statistically analyzed by completely randomized designed using one way ANOVA for differences among mean mineral concentrations of different sub-locations and *t*-test for comparison between seasons (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Forage: In barseem fodder, the higher Ca and P concentration was found in D. G. Khan Irrigated zone than Thal Irrigated Canal zone (Table: 1) as reported by Ramana *et al.* (2001) and Garg *et al.* (2002) but contradicts with Ndebele *et al.* (2005) and Ashraf *et al.* (2006) who found most of the forages in the critical range. Similarly, the higher P was found in sugarcane top and toria fodders of D. G. Khan Irrigated zone (Table 1). The plant species and seasons may be the factor for the uptake of minerals from the soil. Higher concentration of Ca was estimated in wheat bran, wheat grain and wheat straw whereas not so much difference was observed in P from the concentration reported by McDowell (1992) and NRC (2001).

Blood Plasma Ca & P: In goats, the average values of Ca (9.54 ± 1.24 mg/dl and 10.52 ± 0.94 mg/dl) in both Thal irrigated canal and D.G. Irrigated zones (Table 5) match with Kargin *et al.* (2004) (9.16 ± 0.25 - 13.65 ± 0.54 mg/dl) who reported normal ranges, Gunes *et al.* (2008) and Martins and Neto (1980) but differ with the findings of Khan *et al.* (2003) and Khan *et al.* (2005) who reported deficiency of Ca ($6.0 - 7.67$ mg/dl) in goats in semi-arid region of Pakistan and Gowda *et al.* (2001b) who found lower status of blood Ca values in Eastern and Southern dry zones of Karnataka, Gowda *et al.* (2002) who found the blood Ca level significantly low in the hilly and central dry zone of Karnataka along with Ashraf *et al.* (2006) who reported lower amount of Ca. Significant ($p < 0.005$) difference between Thal canal irrigated and D. G. Khan irrigated zone during both the seasons (Table: 4) matches with the findings of Hidiroglou (1983) who reported Ca concentration in blood plasma affected both with the season and location and Khan *et al.* (2005) who reported significant ($p < 0.05$) difference between seasons and lie within normal ranges. The normal P values in the blood plasma (6.79 ± 0.96 mg/dl and 6.44 ± 0.91 mg/dl) of both the zones (Table: 5), respectively match with the findings of Khan *et al.* (2003) whereas Ramana *et al.* (2000) and Yildiz *et al.* (2005) found P in lower ranges. In sheep, the normal ranges of Ca in the blood plasma (9.45 ± 0.58 mg/dl and 10.8 ± 0.63 mg/dl) in Table 5 match with the findings of Gunes *et al.* (2008) and Sowande *et al.* (2008) found Ca concentration in normal ranges. Significant ($p < 0.05$) difference was found in the Ca level of blood plasma in the both the zones (Table 4 & 5) during both seasons which match with findings of Hidiroglou (1983) who reported Ca concentration in plasma affected both with the seasons and location. The normal values of P (6.75 ± 1.1 mg/dl and 6.44 ± 0.31 mg/dl) in the plasma of sheep of both zones (Table 5) and during the winter and summer seasons (Table 4) with findings of Gowda *et al.* (2001a) who reported P (5.1 ± 0.73 mg/dl) in sheep, also with (Kargin *et al.*, 2004) who reported P value (5.36 ± 0.26 - 7.18 ± 0.26 mg/dl) in sheep within the reference range, also with the result of Gunes *et al.* (2008) and Sowande *et al.* (2008) who reported normal value of P. Normal and significant concentration of P in both Thal canal irrigated zone and D. G. Khan irrigated zone in both winter and summer seasons (Table 4) contradicts with Ramana *et al.* (2001) who found lower P status from Southern Transition zone of Karnataka, Gowda *et al.* (2001b) who found lower P status in Eastern and Southern dry zones of Karnataka whereas Gowda *et al.* (2002) found significantly lower value of P from hilly and central dry zone of Karnataka whereas (Khan *et al.*, 2003) found sheep deficient in Ca during summer season and Khan *et al.* (2005) found lower concentration of Ca in specific ranches of Punjab. The type of plant and availability of Ca and P from the fodder may be important factor for the significant difference ($P < 0.05$) in the blood plasma of sheep and goats.

Table 1. Comparative study of calcium and phosphorus of different fodders and concentrates

Ecological Zone	Barseem		Millet Grain		Rice Grain		Sugar Cane Top		Toria Fodder		Wheat Bran		Wheat Grain		Wheat Straw	
	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P
Thal Irrigated Canal Zone	2.24 ^a	0.42 ^b	0.67 ^a	0.29 ^a	0.24 ^a	0.34 ^a	0.11 ^a	0.14 ^a	2.14 ^a	0.47 ^a	0.28 ^a	1.51 ^a	0.67 ^a	0.4 ^a	0.30 ^b	0.07 ^a
D. G. Khan Irrigated Zone	±0.46	±0.10	±0.44	±0.05	±0.21	±0.02	±0.02	±0.06	±0.28	±0.18	±0.06	±0.01	±0.07	±0.13	±0.06	±0.01
	2.63 ^b	0.44±0.12	0.63 ^a	0.41 ^b	0.39 ^b	0.33 ^a	0.09 ^a	0.22 ^a	2.30 ^a	0.49 ^a	0.29 ^a	1.52 ^a	0.28 ^b	0.54 ^b	0.25 ^a	0.09 ^a
	±0.09		±0.80	±0.14	±0.00	±0.00	±0.02	±0.04	±0.93	±0.15	±0.05	±0.02	±0.08	±0.10	±0.03	±0.02

Table 2. Calcium and phosphorus concentration (mg/dl) in plasma of sheep and goats reared in Thal Irrigated Canal Zone

Sites	Sheep								Goat							
	Winter				Summer				Winter				Summer			
	Adults		Lambs		Adults		Lambs		Adults		Kids		Adults		Kids	
	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P
Khaliqabad	9.93 ^a	7.13 ^a	7.44 ^a	6.85 ^a	9.57 ^a	7.16 ^a	9.57 ^a	6.21 ^a ±0.04	9.12 ^a	6.65 ^a	8.98 ^{ab} ±0.01	6.69 ^a	9.57 ^a	5.91 ^a	9.57 ^a	7.23 ^a
	±0.01	±0.05	±0.01	±0.97	±1.44	±0.83	±1.46		±0.01	±1.81		±1.61	±0.00	±0.00	±0.56	±0.29
Quaidabad	9.57 ^a	6.65 ^a	9.24 ^b	7.11 ^a	9.57 ^a	6.01 ^a	9.57 ^a	5.96 ^{ab} ±0.82	9.57 ^a	6.86 ^a	9.47 ^a ±0.00	6.98 ^a	9.57 ^a	6.18 ^a	9.57 ^a	6.40 ^a
	±0.11	±0.29	±0.00	±0.00	±0.01	±1.31	±0.01		±0.01	±0.3		±1.72	±0.01	±0.61	±0.01	±0.06
Mitha	8.06 ^b	6.60 ^a	9.57 ^b	6.97 ^a	9.57 ^a	5.64 ^a	9.57 ^a	6.85 ^{ab} ±0.11	9.90 ^b	6.82 ^a	8.95 ^b ±0.01	6.66 ^a	9.57 ^a	7.11 ^a	9.57 ^a	6.15 ^a
Tiwana	±0.11	±1.10	±0.01	±0.04	±1.06	±0.96	±0.01		±0.01	±1.66		±2.06	±0.38	±0.42	±0.86	±0.67
C. V. H.	9.57 ^a	7.13 ^a	9.57 ^b	6.91 ^a	9.57 ^a	7.39 ^a	9.57 ^a	6.37 ^{ab}	9.57 ^a	6.77 ^a	9.57 ^a ±0.56	6.87 ^a	9.57 ^a	6.86 ^a	9.57 ^a	6.91 ^a
Roda	±0.11	±0.22	±0.01	±0.04	±0.01	±0.05	±0.01	±0.05	±0.00	±1.56		±0.05	±0.01	±0.39	±0.01	±0.05
Hamoka	9.57 ^a	6.55 ^a	9.57 ^b ±0.05	6.26 ^a	9.57 ^a	7.17 ^a	9.57 ^a	6.43 ^b ±0.06	9.57 ^a	6.79 ^a	9.57 ^a ±0.01	6.63 ^a	9.57 ^a	6.91 ^a	9.57 ^a	6.91 ^a
	±0.11	±0.05		±0.10	±0.01	±0.03	±0.09		±0.23	±0.21		±0.00	±0.21	±1.09	±0.00	±1.12

Table 3. Calcium and phosphorus concentration (mg/dl) in plasma of sheep and goats reared in D. G. Khan Irrigated Zone

Sites	Sheep								Goat							
	Winter				Summer				Winter				Summer			
	Adults		Lambs		Adults		Lambs		Adults		Kids		Adults		Kids	
	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P
Khar Gharbi	10.75 ^a	6.16 ^a	10.75 ^a	6.23 ^a	11.7 ^{ab}	4.55 ^a	12.09 ^a	5.07 ^a	10.15 ^a	6.28 ^{abc}	10.15 ^a	6.37 ^a	10.43 ^a	6.85 ^a	9.88 ^{ab}	6.63 ^{ab}
	±1.49	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±1.14	±0.51	±0.79	±0.00	±0.00	±0.00	±0.00	±0.00
Muradabad	10.75 ^a	6.65 ^a	10.75 ^a	6.63 ^a	12.1 ^a	4.55 ^a	12.09 ^a	5.07 ^a	10.15 ^a	6.98 ^b	10.15 ^a	7.35 ^a	10.30 ^a	6.54 ^a	10.69 ^{ab}	7.24 ^{ab}
	±0.00	±0.00	±0.00	±0.00	±0.00	±0.51	±0.00	±0.00	±1.59	±1.02	±0.95	±0.00	±0.00	±1.23	±0.00	±0.00
Shah jamal	10.75 ^a	6.58 ^a	10.75 ^a	6.63 ^a	11.91 ^b	4.75 ^b	10.09 ^a	6.65 ^a	10.15 ^a	7.36 ^{abc}	10.15 ^a	5.39 ^a	10.1 ^{ab}	6.87 ^a	12.27 ^{ab}	6.50 ^{ab}
	±1.06	±0.80	±1.82	±1.16	±0.00	±0.00	±0.00	±0.00	±0.94	±0.16	±0.75	±0.68	±0.00	±0.00	±0.00	±1.05
Bet Mir	10.75 ^a	6.58 ^a	10.75 ^a	6.63 ^a	9.42 ^a	6.50 ^a	9.44 ^a	7.04 ^a	10.15 ^a	4.49 ^c	10.15 ^a	6.61 ^a	10.38 ^a	5.69 ^a	10.00 ^a	5.57 ^a
Hazar	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.95	±1.25	±1.13	±1.02	±0.00	±1.14	±0.00	±0.19
Chandarban	10.75 ^a	6.58 ^a	10.75 ^a	6.33 ^a	10.42 ^a	6.51 ^a	9.45 ^a	7.02 ^a	10.15 ^a	7.38 ^b	10.15 ^a	6.9 ^a	9.29 ^b	6.01 ^a	9.13 ^b	6.70 ^b
	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.47	±1.7	±0.82	±1.65	±1.09	±0.00	±0.96	±0.00	±0.00

Table 4. Comparative analysis of calcium and phosphorus of blood plasma among zones during summer and winter seasons

Ecological Zones	Goats				Kids				Sheep				Lamb			
	Winter		Summer		Winter		Summer		Winter		Summer		Winter		Summer	
	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P	Ca	P
Thal Canal Irrigated zone	9.54 ^a ±0.83	6.78 ^{a±} 0.78	9.55 ^a ±0.00	6.8 ^{a±} 0.54	9.31 ^{a±} 0.47	6.76 ^a ±0.57	9.57 ^a ±0.01	6.72 ^a ±1.36	9.34 ^a ±0.83	6.81 ^{a±} 0.78	9.56 ^{a±} 0.01	6.70 ^{a±} 0.54	9.07 ^a ±0.74	6.82 ^{a±} 0.39	9.56 ^a ±0.01	6.75 ^a ±0.45
D. G. Khan Irrigated Zone	10.15 ^b ±0.00	6.50 ^a ±0.23	10.9 ^{b±} 0.87	6.39 ^{a±} 0.37	10.5 ^{b±} 0.75	6.54 ^a ±0.71	10.6 ^b ±0.88	6.52 ^b ±0.38	10.7 ^b ±0.00	6.50 ^{b±} 0.23	10.9 ^{b±} 0.87	6.39 ^{b±} 0.37	10.7 ^{b±} 0.00	6.49 ^{b±} 0.21	10.7 ^{b±} 0.80	6.49 ^{ab} ±0.50

Table 5. Comparative analysis of plasma calcium and phosphorus among the ecological zones of the Punjab

Ecological Zones	Goat		Kid		Sheep		Lamb									
	Ca	P	Ca	P	Ca	P	Ca	P								
Thal Irrigated Canal Zone	9.54 ^{a±} 1.24		6.79 ^{a±} 0.96		9.44 ^{a±} 0.34		6.74 ^{a±} 1.03		9.45 ^{a±} 0.58		6.75 ^{a±} 1.1		9.31 ^{a±} 0.53		6.78 ^{a±} 0.42	
D. G. Khan Irrigated Zone	10.52 ^{b±} 0.94		6.44 ^{a±} 0.91		10.55 ^{b±} 0.79		6.53 ^{a±} 0.61		10.8 ^{b±} 0.63		6.44 ^{b±} 0.31		10.7 ^{b±} 0.56		6.49 ^{a±} 0.38	

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