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METABOLIC PROFILES IN BUFFALO HEIFERS BRED IN TWO FARMS WITH DIFFERENT FEEDIND AND CLIMATIC CONDITIONS

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SUMMARY

Parameters of energy, nitrogen and mineral metabolism were monitored in 60 buffalo heifers for ten months before puberty. The animals were belonging to two farms with different feeding and climatic conditions. Feeding level, had greater effect than climatic conditions, on daily weight gain age of puberty, haematic glucose, cholesterol and urea, but not proteins and mineral metabolism.

Globulins, urea, calcium and phosphorus levels were moderatly influenced by season.

Keywords: Buffalo heifers, feeding level, puberty, metabolic profile

INTRODUCTION

Previous works in Italy were carried out to measure different factors (bull, nutritional level, season, climate, health etc.); influencing onset of puberty, growth rate and sexual maturity in buffalo heifers (Seren et al., 1991; Campanile et al., 1991 a; Terzano et al., 1991; 1993; Esposito et al., 1993; Borghese et al., 1993 a; 1993 b; & 1994).

The present work was intended to analyze some indicators of energy, nitrogen and mineral metabolism, in heifers in two farms under different climatic and feeding conditions, in order tó explain the differnt results obtained regarding body growth and puberty age and to understand how some haematic parameters could be utilised in the diagnosis of various pathologies and to reveal whether the requirements are satisfied or not for the buffalo species.

MATERIALS AND METHODS

The study was undertaken on 60 buffalo heifers one year old, bred in two differnt Italian farms (n=30 in each farm). The animals were raised in two locations in Italy: the "D farm", 41° N (Caserta province) and the "J farm", 40.5° N (Salerno province).

The experiment was carried out from October to July. The animals were fed silo-mais, hay and concentrate; in the first period (385-500 days old). Heifers in D farm receveid 4.21 MFU (milk feed units) vs 3.73 on J farm. In the second period (500-650 day old) they had 5.10 and 4.42 MFU in D and J farms, respectively. The MFU/Kg D.M. were 0.76 and 0.75 respectively in D and J farms. During the trial crude protein was 630-730 g/d on both farms. Mineral and vitamin requirements were satisfied.

The live weight of each animal was recorded monthly. Onset of puberty was tested by rectal palpation and by haematic progesterone determination at ten days intervals by the RIA method (Esposito et al., 1993). As the buffalo heifers reached puberty, they were left out of the trial.

Metabolic profile was tested in monthly blood samples. Samples were taken from jugular vein into heparinized vacutainer tubes and plasma was (kept at -20°C till the time of assay). Glucose, cholesterol, total protein, albumin, globulins, urea, calcium, and phosphorus were determined.

Ambient temperature and relative humidity were recorde%wout at the time of sampling.

Statistical analysis was executed according to the following factorial model:

$$Y_{ijk} = n + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$$

Steady factors were considerd and the effects of each one of them was expressed as variations of general average;

Y_{ijk} = as value observed in k heifers on i farm and in j season;
n = constant common to all observations
α_i = steady effect common to all observations relative to the i farm ;
β_j = steady effect common to all observations relative to j season;
$(\alpha\beta)_{ij}$ = steady effect common to all observations relative to i farm and j season interaction;
e_{ijk} = casual residual error and or unexplainable effects.

Factors were separtely and interactively considered (meanly). Student's test revealed the significance of difference between means.

RESULTS AND DISCUSSION

1. Energy metabolism

Glucose: The mean value of glucose concentration was higher in animals bred in D than those bred on J farm (62.00 vs 59.46 mg/dl). Glucose showed a similar trend in both farms (Fig. 1), nevertheless a significant difference was observed among seasons ($P \leq 0.05$, $P \leq 0.001$).

The low level of glucose of heifers in J farm particularly during the second period may be due to the low level of nutrition (Bonsembiante and Bittante, 1980 and Hancock et al., 1988). The heifers showed a fall to a minimum glucose value, 40 mg/dl, with negative effects on daily weight gains and puberty age. In fact, until the age of 500 days (February test) the heifers in J farm had a high daily gain (708 g/d) and a high glucose level, while from the age of 500 to 650 days (July test) daily gain, decreased to 289 g/d vs 465 g/d in D farm. This may be due to 4.42 MFU/d was not sufficient during the period of maximum body growth near sexual maturity. Feeding level affected puberty too, as found by Asghar et al. (1983); Chaudhary et al. (1983); Kaur and Arora, (1989); Terzano et al. (1993); Borghese et al. (1994). In D farm 28 out of 30 heifers reached puberty before the age of two years (612 days), while in J farm only 7 out of 30 heifers reached puberty during the same period, age similar to that reported by Borghese et al. (1993 b). The D farm showed better results, even in worse climatic conditions. In fact it is an inland farm, so daily average temperature and humidity were less uniform than on J farm, which had mitigating benefits of sea influence.

Under high feeding level (4.5-5.5 MFU/d) all heifers (30) reached puberty at age of 598 days, with daily gain of 730 g/d during the 500-650 days period, in agreement with Borghese et al. (1993 b), coincedent with mean of 75.7 mg/dl haematic glucose equal to the finding of Borghese, (1994).

Therefore, haematic glucose trend could be utilized as an indicator to know whether requirements are satisfied or not, particularly concerning body weight and growth in buffaloes.

Cholesterol: Heamatic cholesterol level was significantly higher (p=0.001) in J farm (Fig. 2) where heifers energy was not satisfied. Similar trend resulted also on farm D. Therefore, the cholesterol level appeared significantly and inversely correlated with glucose level in both farms. This results is explainable by several previous research works. Haematic cholesterol level increases by an energetic and fat diet intake. It is normally increased by an energy feeding defect, because of fat deposits moving, as observed in bovine cows (Peterson and Waldern, 1981; Bertoni, 1987), and goats (Terzano et al., 1988 and 1994) and buffalo cows (Zicarelli et al., 1986). In buffalo cows 60-70 mg/dl (1.55-1.81 mmol) cholesterol was found found before calving, with a considerable increase (2.59-3.55 mmol/l) at the beginning of lactation, due to greater energy requirement.

2. Nitrogen metabolism

Total protein: Blood protein level was exactly the same for animals in both farms (6.66 g/dl), and very similar to the values found by (Bertoni et al., 1993). The constant mean of protein may be due to the function of rumen bacteria in producing an unknown quantity between nitrogen input and output.

Total protein fluctuated slightly, both for single and seasonal tests (Fig. 3). This shows that such biological indicator is really uniform in buffaloes, even they are bred in different feeding and environmental conditions.

Albumin and globulins: Albumin concentration was similar in heifers of both farms (3.50 g/dl in D, 3.46 in J). Values trend was exactly the same. Similar trend

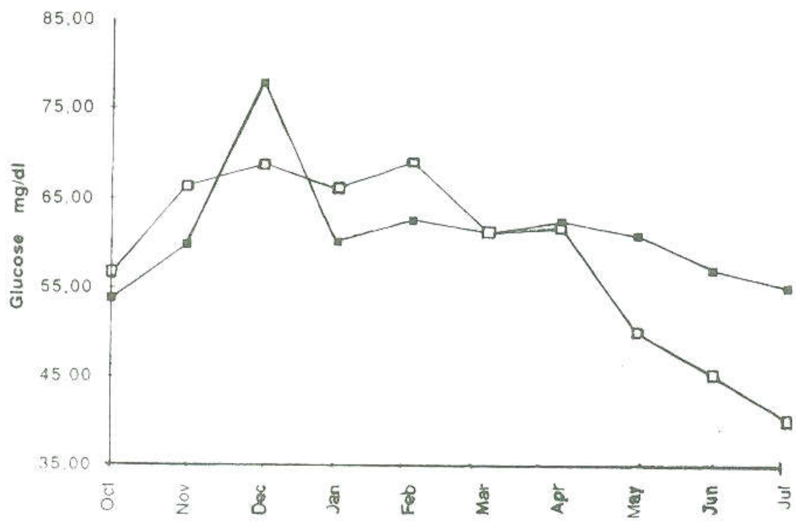

Fig. 1. Glucose trend in heifers of 'D' —■— and 'J' —□— farms.

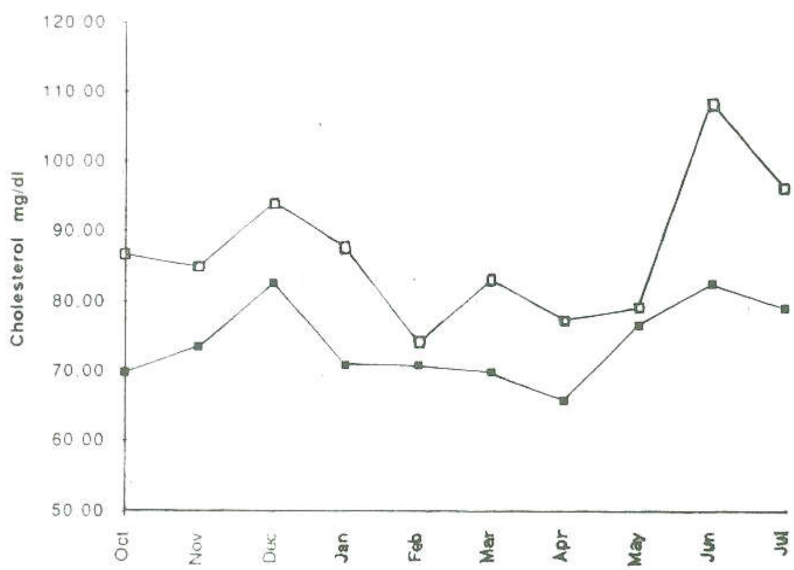

Fig. 2. Cholesterol trend in heifers of 'D' ■ and 'J' __ __ farms.

was observed for globulins, (average value was 3.21 on J farm and 3.16 on D farm), however the trend showed a slight increase in summer time in J farm, and in winter in D farm. Significat variation in gammaglobulins was observed by Campanile et al. (1991) in buffalo cows with a high incidence of endometritis: 2.16 g/dl vs 1.86 in healthy buffalo cows; therefore gammaglobulin level could be used as an indicator for health state in buffalo herd.

Urea: Urea level was very similar in both farms (25.65-26.74 mg/gl in D and J farms, respectively) while its ternd (Fig. 4) showed considerable fluctuations with significat difference between tests and between seasons. In fact haematic urea level is very variable, depending on protein degradation for gluconeogenesis, normal catabolism of aminoacids and rumen ammonia. Urea normally is higher when protein is in excess in the diet or there is a low energy /protein ratio or during lactation (Bertoni et al., 1993).

Terefore, the urea high level in heifers of this trial could be due to the low energy/protein ratio and to gluconeogenesis by protein degradation in conditions of insufficient energy for growth.

3. Mineral metabolism

Calcium (10.14 mg/dl) and phosphorus (6.90 mg/dl) mean values were the same in both farms, even the ratio Ca/P was almost the same (1.47). Calcium was higher in winter, than in autumn and summer (Fig. 5), even the variability was very limited (9.5-11.0 mg/dl). Since Ca homeostasis, controlled by vit. D, calcitonine and parathormone it does not change more than 3% out of about 10 mg/dl mean value (Borghese, 1994). Only in particular diseases (rachitism, ostheomalacy, Ca altered absorption) and conditions (great Ca requirement during milk production), calcium blood level could be modified. Then calcium could be utilised as an indicator of important mineral alterations.

Phosphorus level trend (Fig. 6) tended to rise from autumn to winter and then to fall progressively until summer time in D farm, with some differences just in winter vs J farm. Ca/P ratio trend was very regular and limited between 1.4-1.6. Calcium was significantly correlated in both farms with glucose and urea ($P \leq 0.01$);

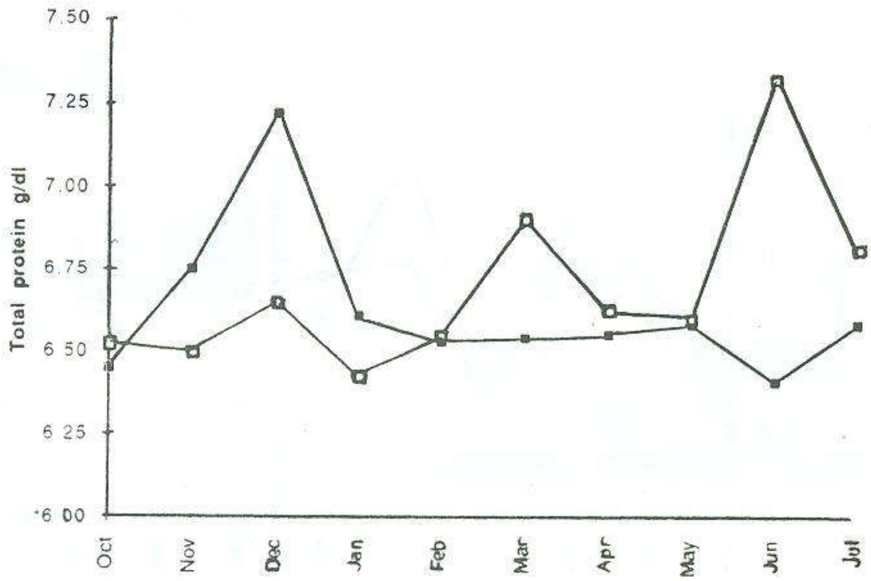

Fig. 3. Total protein trend in heifers of 'D' —■— and 'J' —□— farms.

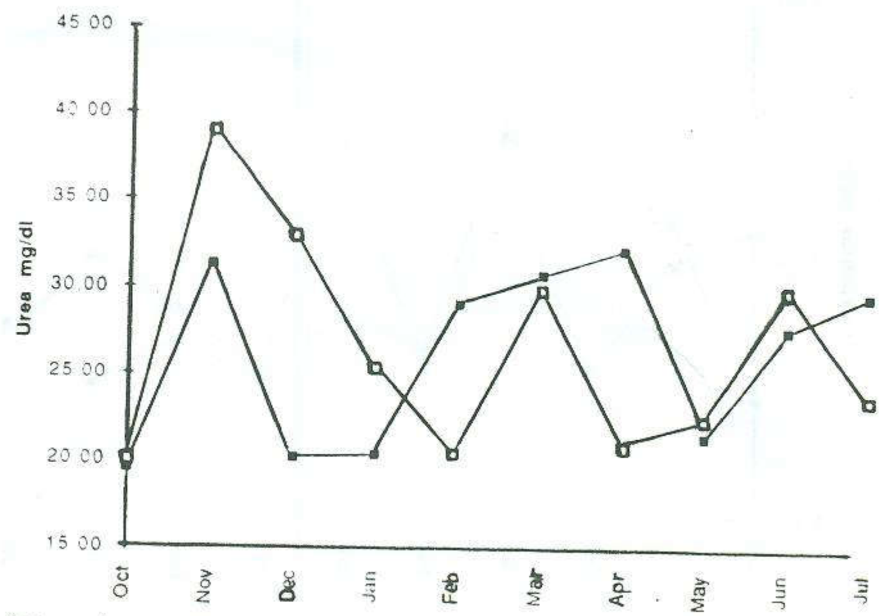

Fig. 4. Urea trend in heifers of 'D' ■ and 'J' —□— farms.

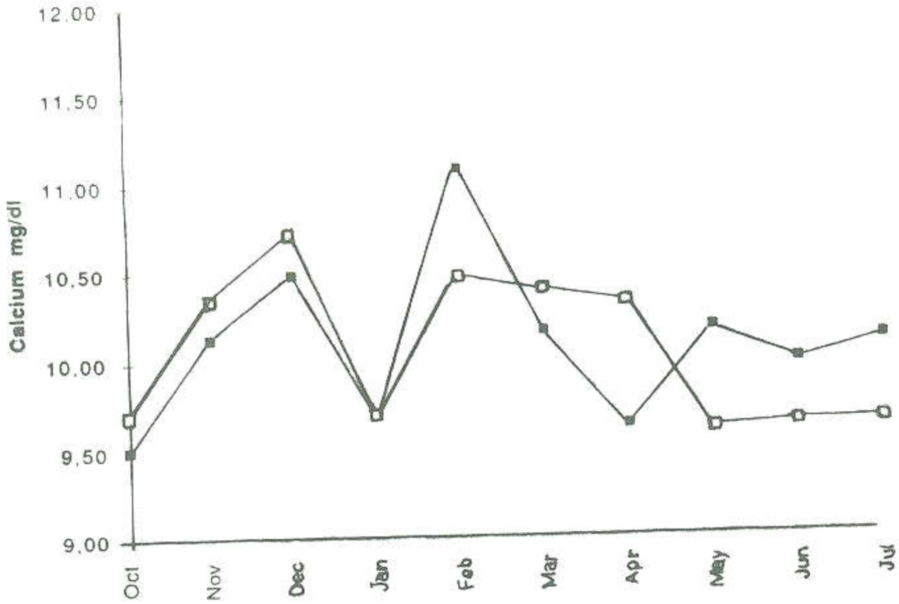

Fig. 5. Calcium trend in heifers of 'D' —■— and 'J' —□— farms.

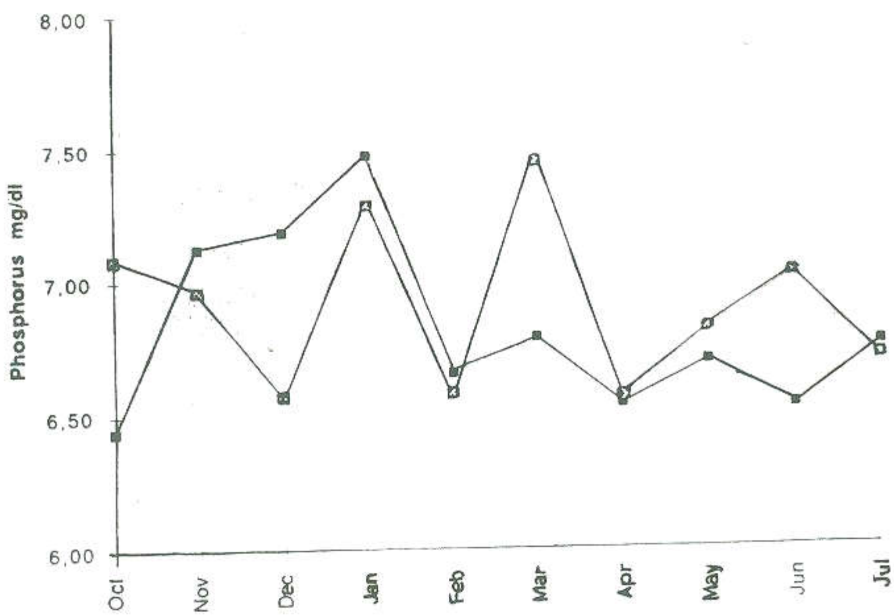

Fig. 6. Phosphorus trend in heifers of 'D' —■— and 'J' —□— farms.

probably due to the connection between skeleton building up and nitrogen metabolism during heifer growth.

CONCLUSION

Metabolic profile of glucose and cholesterol in buffalo heifers may be considered useful for determining whether energy requirements are satisfied or not during growth and sexual maturity. Urea may be an indicator of protein degradation, while calcium and phosphorum indicate the physiological status of mineral metabolism during skeleton growth.

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النشـاط التمثيلـى لعجـلات الجـاموس المربـاه فـى مزرعتيـن مختلفتيـن فـى المستوى الغذائى والظروف المناخية

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أستخدم فـى هذه الدراسـة ٦٠ عجلـه جاموسـى عمـر سـنة لقيـاس النشــاط التمثيلـى للطاقـه والنـتروجين والامـلاح المعدنيـة . كــانت الحيوانــات تابعــة لمزرعتين تختلفان فى المستوى الغذائى والظروف المناخية.

وقد أثبتـت النتـائج أن المستوى الغذائـى كـان اكـثر تـأثيرا مــن الظــروف المناخيـة فـى معــدل الزيــادة اليوميــة وعمــر البلــوغ ومســتوى الجلوكــوز والكلولسترول بينما لم يتأثر مستوى كل من البروتين والاملاح المعدنية. أما مستوى الجلوبيولين واليوريا والكالسيوم والفوسفور فتأثرت بالموسم .