STUDIES ON CARBOHYDRATE METABOLISM IN YOUNG RUMINANTS

BY

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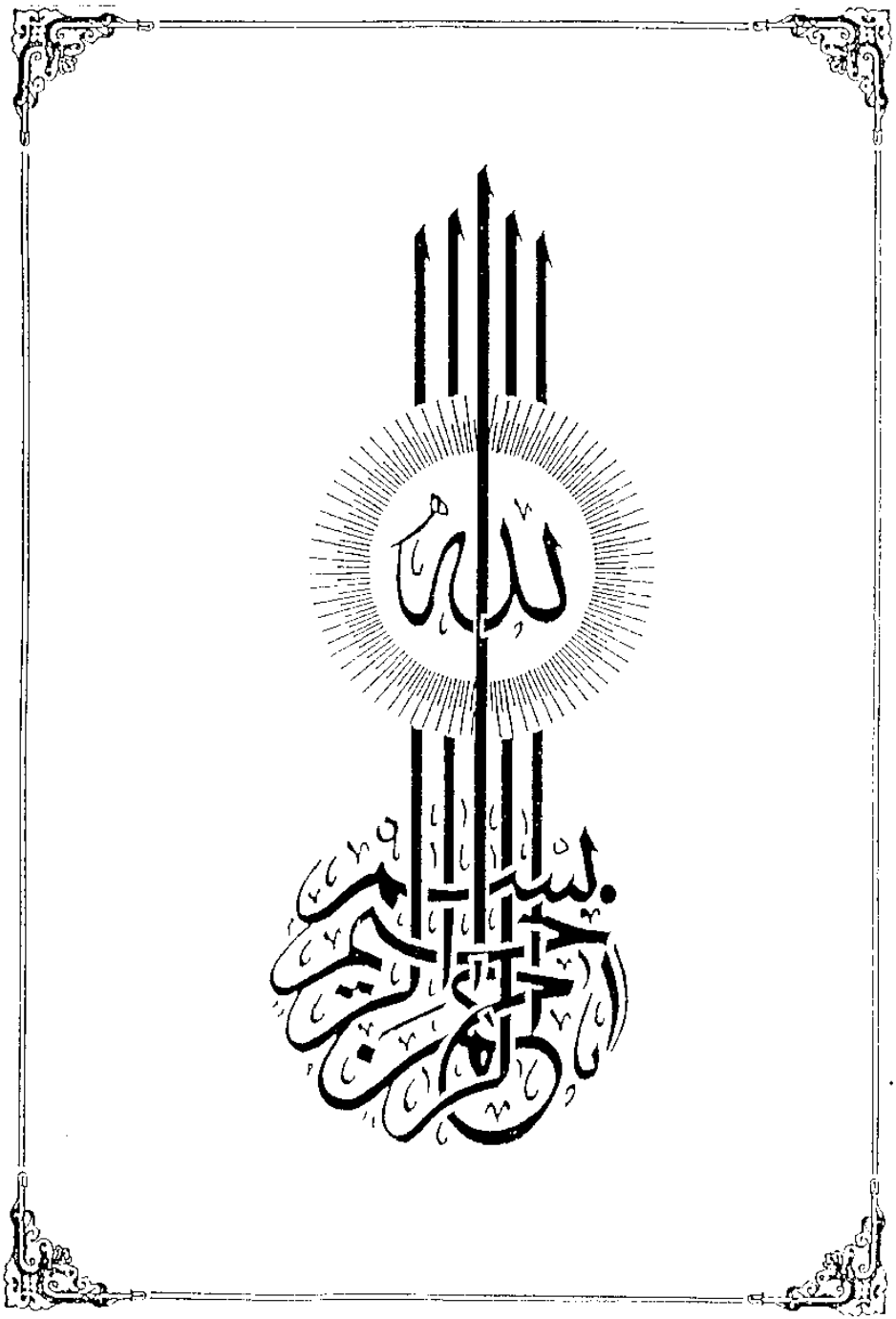

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C O N T E N T S

these factors are the rumen development, age, and type of ration. Therefore, it is expected as has been proved true, that carbohydrate metabolism will differ in young ruminant than in the case of adults. This difference will certainly affect the economy of feed utilization in these animals on certain diets.

The main object of this experiment was to study carbohydrate metabolism in young lambs when fed rations differ in their concentrations of energy and protein. It is anticipated that carbohydrate metabolism will be affected by the advance of the animals in age and the energy-protein ratio.

REVIEW OF LITERATURE

1. Effect of Energy and Protein Levels on Body Weight Gain.

The issue of body weight gain as affected by levels of energy and protein in rations for fattening or growing lambs, had been intensively investigated.

Jones and Hogue, (1960) fed lambs, weighing about 32 kg., rations with two levels of energy and protein, i.e. 90 and 120 % of the minimal level recommended by Morrison (1957). It was concluded that body gains were greatest when the low energy low protein ration was fed, intermediate for both the low energy-high protein and high energy-low protein rations. However, body gain were the least when the high energy high protein rations was fed.

However, lambs fed high protein rations gained higher and were more efficient than did those fed the low protein rations.

On the other hand, Church et al. (1966), working on lambs, used rations containing 14 or 18% C.P. The energy concentration in these rations was either 0.75 or 0.93 MCal NE/kg of feed. No significant differences were detected

either in live weight gain or feed efficiency between the four groups of lambs.

It was concluded that, at lower energy levels, protein spared energy.

No significant difference in average daily gain was observed when the ME of the ration was reduced from 2.9 to 2.5 Mcal / kg D.M. (Andrews et al. 1969).

However, Allen (1969) found that higher energy levels increased body gain and feed efficiency, though not significantly, when all concentrate diets were fed to the lambs. The diets contained 2.45, 2.65 or 2.85 Mcal / kg fresh weight and three levels of protein 12, 16 and 20% C.P.

Apart from energy and protein levels, concentrate to roughage ratio were one of the factors that affects body weight gain of growing and fattening lambs; Whiting and Clark (1956) used a wide range of concentrate to roughage ratio, 2:1, 1:1, 1:2 and free choice about 5:1, for feeding ram lambs. Daily gain and efficiency of feed conversion were signficantly affected by C / R ratio.

Schneider et al., (1963) found that average total gain was greater when the propertion of concentrate in the diets

increased and was least as the proportion of roughage in the diets increase. Nevertheless, daily gain was almost similar when rations of 80:20 and 50:50 concentrate to roughage ratios were fed (Kaun et al., 1962).

II. Total Volatile Fatty Acids (VFA) in Rumen Liquor and Blood Serum :

There is no doubt that the main end products of various food components breakdown in the rumen are volatile fatty acids (VFA) and ammonia, (Hungate, 1967; El-Shazly, Abou Akkada, Naga, 1963). The total VFA produced in the rumen (mainly acetic, propionic and butyric acid), provide the ruminants with 20-50 % of the daily energy requirement, (Blaxter, 1961).

In addition to that, the amount of VFA produced in the rumen is highly correlated with total organic matter digested in the alimentary tract.

Weston and Hagan, (1968) reported that the production of VFA was correlated with the total amount of organic matter digested in the alimentary tract (r = 0.93 - 0.95). The mean VFA production per 100 g of organic matter digested in the alimentary tract was equivalent to 56.8 g 243 Kcal, or

0.85 mol . Rates of VFA production and VFA absorption from the rumen were correlated with VFA concentration in rumen liquor (r = 0.67, r = 0.67) and the rumen VFA pool (r = 0.81, r = 0.79). Approximately 76 % of the VFA produced in the rumen was absorbed from the rumen, 19% was absorbed from the omasum and abomasum, and 5% passed from the abomasum to the intestines.

In an experiment, mature wethers were fed diets consisting of four levels of protein (4.00, 11.08, 18.72 and 26.03%) at three levels of energy intake (75, 100 and 125 % of maintenance). Taka et al. (1969) found that the concentrations of the total VFA varied significantly ($p < 0.05$) among protein levels. This variation was curvilinear with highest mean on the 11.08 % protein diet. They also stated that total variation of VFA among the energy levels had a significant ($P < 0.05$) linear component. The acetic acid increased in a linear fashion ($P < 0.05$) as energy intake increased and in a curvilinear fashion ($P < 0.01$) with increasing protein levels in the diet. The highest mean concentration was on the 11.08 % protein diet whereas the lowest concentration was on the 4.00 % protein diet.

The diuration of protein supplementation has been found to affect VFA concentration in the rumen. Feeding cottonseed meal every day as compared with once every six days, resulted in a significant increase in VFA production in the rumen whereas blood picture did not change (Nelson and Watkins, 1967).

Singh and Ranhorta, (1971) fed sahiwal cattle and Murrad buffaloes, wheat straw to appetite and concentrate mixture to provide 1.277, 2.335 or 3.176 Mcal with a constant intake of 218 g protein. Total VFA concentration rose sharply at 2 hr after feeding and then declined gradually, it was not affected by energy intake. On the other hand, acetate concentration was reduced while propionate concentration increased as the energy intake from concentrate was increased. Concentration of acetate and of total VFA were greater in cattle and ratio of acetate to propionate tended to be wider.

Danilenko and Mirosnik (1971) fed groups of ewes, for 180 days, diets in which easily digested carbohydrates were provided by maize and barley meal or fodder beet or sugar. Sugar : protein ratios were 0.27, 0.95 and 1.65. Maize and barley meal or fodder beet gave a sustained high value for rumen VFA from 2 hr after feeding while sugar caused a rise

to a peak at 2 hr. after feeding then values fell rapidly.

Devuyst et al. (1969) in their studies on nine adult sheep with rumen fistula fed either a basal lucern diet (controls) or the basal diet with glucose or starch 15 %. Five samples of rumen fluid were collected daily and VFA concentration were estimated. Compared with values in the rumen of controls the sheep given the diet containing glucose had decreased acetic acid concentrations while it increased concentrations of propionic and butyric acids. Sheep given the diet containing starch, which had a slower but more lasting effect than glucose, showed decreased propionic acid concentrations and increased concentration of acetic and butyric acids. Results were affected by time interval between intake of food and collection of sample. Arrival of food in the rumen increased the concentrations of VFA.

Moreover, the effect of variation in roughage to concentrate ratios on VFA concentration had been also studied. In their experiment, Mital et al. (1970) fed lambs, 3 months of age, consequently on one of the following diets, viz; 200 g balanced concentrate mixture and 8 hr grazing; cut green berseem alone; 50 g groundnut cake and 8 hr grazing; the last with a Co supplement given by rumen fistula daily.

VFA concentrations were higher after than before feeding but the increase was less on cut green feed than on the other diets but not on diet with added Co.

Three mature sheep grazed on a pasture mainly of perennial ryegrass and white clover in autumn in New Zealand Total VFA increased from 10.8 m.mols per 100 ml at 9 a.m. to 17.5 m.moles at 9 p.m. then declined again during the night. As total VFA increased the proportion of acetic acid fell and propionic and n-butyric acids rose (Ulyatt and Henderson, 1969).

The above mentioned literature concentrated mainly on the relationships between VFA production in the rumen and the rations fed. However, age of the animals on the other hand, had a signficant role in affecting the VFA production in the rumen;

Borhami et al. (1967) reported that the VFA concentration in calves was lowest at two-four weeks (3.47-4.24 meq./100 ml of rumen liquor) and reached the highest level between 6-12 wk (5.09-5.87 meq./100 ml rumen liquor). There was a slight drop after this age, followed by a gradual increase in concentration.

Kurilow et al. (1968) used 6 calves from 6 days to 5 months and 16 lambs from 2 days to 5 months of age, from which rumen fluid and blood were obtained at intervals. In the calves, at 6 days, rumen contents had 2.15 m.moles VFA per 100 ml. VFA reached adult level by 3 months, 6.84 m.moles per 100 ml. In the lambs VFA continued to rise throughout the 2 months of study but the proportion of acetic, propionic and butyric acids in the total VFA were fairly constant.

Ndumle et al. (1964) indicated that the level of total volatile fatty acids in rumen liquor increased with age of the calves and were significantly higher at 6 weeks in the early-weand group than in the late-weaned group. Also, Orari et al. (1970) found that in early weaned calves (5 weeks) VFA increased with time after feeding to a peak 4 to 8 hr after feeding which was highest at 8 weeks.

Steger et al. (1970) found that with calves fed milk diets the content of VFA was about 65 % but with concentrate diets it varied between 60 to 80 %. As the age of the animals advances the proportion of VFA also increased, with a shift towards propionic acid.

Zerebcave et al. (1970) reported that total VFA in the rumen increased up to 3 months of age but then gradually