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**PARTIAL REPLACEMENT OF PROTEIN BY NON
-PROTEIN NITROGENOUS SOURCES IN THE
RATIONS OF MILKING COWS**

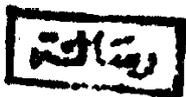
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I N T R O D U C T I O N

Livestock industry in Egypt will expect to face a shortage in feed stuffs, because of the ever increasing numbers of livestock and the limitation of feed sources. Besides, grains and legume seeds, which may contribute a big share in animal nutrition, are rather expensive and used mainly for human consumption.

Protein is often a limiting nutrient for ruminants. Usually, the animals in Egypt suffer from protein deficiency in the summer seasons where green fodders are scarce.

It is very important therefore, to introduce new sources of protein in the rations of ruminants taking into consideration the struggle between man and farm animals for food.

Attention has been focused on urea as a non-protein nitrogenous source (as it is considered one of the cheapest sources of protein than the other

protein feed stuff sources and it can be produced artificially) to replace a part of protein requirements for ruminants.

The objective of the present work is the study of the effect of partial replacement of protein by urea in the rations of dairy cows.

Because most dairymen recommend that rice bran must be maintained at low levels in the rations because of its adverse effect on the production performances of the dairy cows, so, two levels of rice bran were incorporated in the rations in order to study their effect on the production performances of the lactating cows.

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REVIEW OF LITERATURE

I. Mechanism of Non-Protein Nitrogen Utilization :

There is no doubt that the rumen micro-organisms play an important role in ruminant nutrition, particularly the utilization of non-protein nitrogen. It is well established fact that when urea enters the rumen, it is rapidly dissolved and hydrolysed to ammonia by bacterial enzyme urease. The ammonia can then be utilized by the rumen micro-organisms for synthesis of amino-acids into microbial proteins which in turn are available for digestion by the host animal. Amino groups are also split from amino-acids and from intact proteins and used by bacteria in the same manner (Reid 1953, Virtanen 1966 and F.A.O. 1968). Fig. 1.1. illustrates the reactions of nitrogen compounds in the rumen.

The extent of dietary protein breakdown in the rumen depends upon a number of factors of which the chemical and physical properties of the protein with special reference to its solubility in rumen fluid appear particularly important. Values ranging from almost complete hydrolysis of grass proteins, 90% for casein and 60-83% for wheaten hay, through groundnut and herring meal, to 40% hydrolysis for the relatively insoluble maize protein, zein have been recorded. Thus

considerable amounts of the protein nitrogen fed to ruminants are, in fact, serving as a source of non-protein nitrogen for rumen micro-organisms.

When ammonia is produced too rapidly in the rumen, its concentration becomes too high, appreciable amounts are absorbed directly into the bloodstream, reconverted to urea in the liver, excreted through the kidneys in the urine and thus lost to the animal. There is, however, always a small amount of urea in the bloodstream and other body fluids. This urea finds its way into the saliva and re-enters the rumen. Urea has been shown to pass into the rumen directly through the rumen wall from the circulating blood.

Samples of rumen ingesta taken from the gastric fistula of a steer were used in studies in vitro to investigate its action on urea (Pearson and Smith 1944). They concluded that all of the urea which would ever be likely to be fed to a cow will be converted to ammonia within an hour. The urease preparation derived from the rumen contents was found very similar to that from soya or jack beans in its behaviour to temperature, PH and inhibitors.

The rate of urea utilization in the rumen of cows and goats were studied by Kaishio et al. (1952). They found

that from 14 to 77 per cent of the urea had been decomposed in the rumen of cows. The total nitrogen and urea nitrogen were estimated in the contents of different parts of the digestive tract. After 4.5 hr. about half the ingested urea was found in the rumen and after 12 hr. only 13 per cent was detected. There was little decomposition of the urea in the omasum and abomasum. In goats however, one-half of the urea was found in the rumen 24 hr. after ingestion.

Broom (1968) found that Holstein cows might produce 3.5 - 4.0 lb microbial protein daily; any remaining requirement of protein would have to be met from dietary protein passing directly through the rumen without being broken down by microbial attack.

II. Factors Affecting Urea Utilization :

1- Level of Protein Intake

The efficiency with which urea is utilized by ruminant animals and the amount of protein that can be replaced by urea have been found to depend on the protein level of the ration. When the ration contains an ample amount of true protein, urea utilization is lower than on protein low rations (Krebs 1938), as far as the synthesis of bacterial protein

from NPN in the rumen is apparent only when protein intake is low.

On the other hand, protein type can affect urea utilization. Mc Naught and Smith (1947) pointed out that when insoluble protein is fed to ruminant, the amount of ammonia formed from this protein is small and this might favor a more efficient utilization of urea. Mc Donald (1952) demonstrated that when zein was fed there was very little increase in the ammonia content in the rumen, but when casein or gelatin was fed large amounts of ammonia were liberated.

2. Available Carbohydrate in the Ration

The breakdown of proteins in the rumen depends upon the proteolytic activity of the particular micro-organisms. These micro-organisms require a source of available energy to resynthesize the nitrogenous compounds in their bodies. There are ample evidences that urea is less utilized when it is fed without concentrate (source of easily fermented carbohydrates). When starch and cereal grains were included in the ration with urea, a rapid reduction of rumen ammonia concentration was observed, suggesting that the starch and cereal grains provided energy needed by the rumen flora to utilize the ammonia

(Mc Donald 1952 and Wetterau et al. 1964). Willett et al. (1946) had noticed that feeding large amounts of cane molasses as soluble carbohydrate with urea had no detrimental effect upon the synthesis of protein from urea in the rumen of dairy cows.

When labeled ammonium sulphate (N^{15}) and urea were the only sources of N in an experimental diet which consisted of 46 to 62% of total carbohydrates as potato starch, 24 to 38 % cellulose and 15 to 23 % sucrose. The milk yield was not affected and the efficient utilization of ammonia and urea in the rumen of these cows was related to the presence of large amounts of soluble carbohydrates in the NPN diet (Virtanen 1968).

3. Effect of Alcohol in Liquid Supplements

In the vast majority of the experiments cited in the literature, it could be concluded that the addition of alcohol to a mixture of molasses and urea has not improved the performance of animals in comparison with a similar mixture without alcohol.

The possibility remains, however; that the ethyl alcohol may increase nitrogen utilization of a molasses-urea mixture for grazing ruminants not receiving supplements of starch containing feedstuffs.

It should be noted that pure ethyl alcohol has a combustible energy value of 7.12 Cal/gm. as against 4.18 Cal/gm. for starch. Alcohol also has the advantage that it can be more easily added to molasses than starch or grains (P.A.O. 1968). Chalupa et al. (1964) using in vitro rumen fermentation techniques, observed that adding small amounts of ethyl alcohol to a basal medium increased cellulose digestion and that equal caloric amounts of starch, acetic acid and other sources of energy had a similar influence. Alcohol supplements did not significantly improve N. retention in growing cattle. There were slightly higher ruminal ammonia level 2 to 3 hours after feeding; this suggests decreased utilization of ammonia for protein synthesis owing to an inhibitory action of alcohol on microbial activity (Chalupa et al. 1964)

4- Effect of Sulfur

Davis et al. (1954) reported that, on rations low in sulfur and high in urea content the addition of sulfate may be desirable. When lambs were fed a purified diet containing urea as the only source of nitrogen, without sulfur supplementation; animals lost body weight and were in negative balance for

both nitrogen and sulfur. The same diet supplemented with sulfates supported positive balances and weight gains (Thomas et al., 1950). Such response would be expected since sulfur is needed for synthesis by rumen bacteria of methionine and cystine as well as thiamine and biotin.

On the other hand, Matsuo and Ushizima (1957) found that the addition of 10 gm. sulfur, cow, day fed 130 or 150 g. urea daily did not significantly increase milk yield, butterfat content or liveweight but the addition of 5g. methionine did significantly increase the milk yield.

It is now accepted that the bacterial protein found in the rumen is deficient in sulfur amino acids such as methionine. Thus the addition of sulfur or methionine increased the nitrogen retention of urea fed animals (Starks et al. 1954 and Thomas et al. 1950).

5- Feed Frequency

In order to get maximum synthesis of microbial protein it is important to keep the rumen fermentation system operating at maximum efficiency for 24 hours each day. This means maintaining the correct ratio of ammonia to available energy and other essential nutrients in the

rumen over prolonged periods of time. When non-protein nitrogen materials such as urea (which is rapidly converted to ammonia in the rumen) are used, this is extremely difficult unless animals are fed frequently. This may be illustrated by the experiment of Broom (1968) who fed five groups of ten animals on a basal barley/mineral/vitamin diet fed ad lib. throughout the day to provide a background of constant energy in the rumen. Against this background the same amount of supplementary nitrogen, in the form either of soyabean meal or urea (2%) was provided, either continuously (by incorporation into the barley) or at a single limited period each day (as a protein concentrate). Results (Table 2.1) indicate significantly higher levels of protein nitrogen in the rumen liquor of animals receiving supplementary nitrogen throughout the day. Also of interest is the fact that urea gave rise to similar amounts of protein in the rumen liquor as did soyabean meal.