

The Effect of the Addition of Urea to Replace a Proportion of Vegetable Proteins in the Diets of the Rabbits

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A SERIES of feeding and *in vitro* experiments were carried out in order to study the nature and fermentative abilities of the contents of the cecum of the rabbit. Also the effect of the cecal contents on the urea utilization was investigated. The results of *in vitro* experiments proved that the cecum is the main fermentative organ of the digestive tract as judged by the chemical composition, especially the levels of VFA. The cecal contents are active in breaking down cellulose giving rise to VFA, but the addition of starch had depressed the cellulose digestion. Proteins of different sources are digested by the cecal contents; ammonia and VFA represent the main end products. It is noted that the cecal contents possess active urease which hydrolyse urea giving rise ammonia, a part of which is converted into microbial protein.

The feeding experiments for 10 weeks showed that adding urea at a level of 1%, has caused a drop in the total bacterial counts in the ceca treated rabbits and no significant change when receiving urea at a level of 3% of the ration. Supplementing the diets with urea caused a significant rise in blood urea of treated rabbits and at 6 weeks, a significant decrease in the levels of blood urea was noted. Feeding rabbits on urea to replace a part or all of the cottonseed cake did not adversely affect the feed intake, daily gain and feed efficiency of treated rabbits over a period of 10 weeks.

Unlike poultry and other farm animals, little research has been carried out on the nutrition of rabbits, especially those aspects dealing with the utilization of cheap non-protein nitrogen sources such as urea. An intriguing question : can other herbivorous such as those with large ceca, utilize urea in a fashion analogous to that in the ruminants. The rabbit seems to be likely subject for studies of urea utilization and the synthesis of microbial protein, because it has a large cecum and it is a true herbivore (Chas and Torver, 1953). The present study is therefore, an attempt to throw some lights on the metabolism of NPN by the rabbit.

Material and Methods

I — *In vitro* studies

1. *Animals and food*

The animals were 5 weeks old of mixed sexes and divided randomly into three groups. Groups 1 and 2 having 3 rabbits each, and group 3 four. Group 1 was fed hay only (roughage) while group 2 received concentrate consisting of corn and cottonseed meal in the ratio of 2:1. The diet of group 3 contained berseem hay; 40%, corn, 20%, barley, 18%, cottonseed meal, 20% and mineral mixture, 2%.

The animals were fed on their respective rations for 4 weeks after which they were slaughtered. Digestive tracts were separated, and divided into four parts; stomach, small intestine, cecum and colon. Contents of each of those parts were obtained independently.

II — *Analytical methods*

1. Complete chemical composition in feeds and in contents of the different parts of digestion were carried out according to Official Methods of the A.O.A.C.; 1960.
2. Total VFA were determined in the cecal contents as described by Abou-Akkada and El-Shazly (1964).
3. Ammonia-nitrogen was determined as described by Abou-Akkada and Osman (1967).
4. Cellulose determination was made by the method of Cramp-ton and Maynard (1938).
5. Microbial protein was determined as described by Barakat (1976).

III — *Feeding experiments*

All experimental animals were weighed at biweekly intervals and the feed intake was adjusted for body weight changes to calculate the feed efficiency.

IV — Determination of blood urea-N and the total number of ce-cal bacteria was performed as described by Barakat (1976). Statistical analysis was carried out according to Snedecor (1956).

This work was carried out at the experimental farm, Faculty of Agriculture, Shebin-El-Koam, Monofia University.

Results and Discussion

1 — *The nature of the digestion tract (DT) of the rabbit*

It is noted that the small intestine is the longest part of DT of the rabbit. Although the cecum is the shortest part, it contains the major share of the contents of DT. It is observed that the dry matter in the contents of small intestine is the lowest when the rabbits are fed on roughages or concentrates. Among all parts of DT, the cecum contains the highest amounts of protein when rabbits were fed on berseem hay whereas the levels of protein in the stomach were similar to those of the cecum when rabbits were fed on concentrates mixture. Both the small intestine and the colon contained minor amounts of the nutrients when rabbits were fed on berseem or the concentrate feed (Table 1). The present observations have suggested that the DT of the rabbit represents a

Table 1 — The chemical composition of contents of DT of Rabbits fed two diets.

Diet	Part of DT	DM %	CP %	EE %	CF %	Ash %	NFE %
Roughage ⁽¹⁾	Stomach	15.7	22.02	6.5	27.43	1.28	42.77
	Small intestine	6.3	9.72	9.3	32.56	4.58	43.04
	Cecum	17.4	26.16	3.2	27.49	2.23	40.92
	Colon	18.2	25.26	5.3	23.61	2.23	42.50
Concentrate ⁽²⁾	Stomach	20.0	16.5	9.6	35.9	9.9	28.1
	Small intestine	8.7	17.3	13.9	35.2	19.2	14.4
	Cecum	20.3	22.4	6.1	31.8	17.7	22.0
	Colon	24.2	18.6	11.0	38.8	16.6	15.0

(1) Roughage diet containing berseem hay only.

(2) Concentrate diet containing corn and cottonseed meal, 2:1 respectively.

modification in which a large cecum is the predominant fermentative compartment as indicated by the nature and the chemical composition of the cecal contents of the rabbits. These findings are in harmony with those of Yoshida *et al.* (1968), Susan and Hiro (1972) and Hoover and Heltonam (1972).

Data in Table 2 represent the levels of the total volatile fatty acids (VFA), ammonia and cellulose in various parts of DT of the rabbits fed on roughage or on concentrates. The cecum seems to contain the greatest amount of VFA on the two tested diets while the colon contained fair levels of VFA when rabbits were fed on the concentrate mixture. The highest levels of ammonia were found in the cecum of rabbits fed on the roughage whereas the stomach and the colon had more of ammonia as the animals were kept on the concentrate feed. It is noted that the levels of cellulose in the cecum were the highest when the rabbits were kept on the roughage diet. The results obtained here were close to those of Hoover and Heltonam (1972). It is interesting to note the similarities between the rabbit and ruminant in the metabolism of dietary protein. The end products appear to be ammonia and VFA by the action of the microorganism in the cecum of the rabbit on the added urea.

TABLE 2. Values VFA, ammonia and cellulose in different parts of DT of rabbits fed two diets.

Diets	Part of DT	Total (VFA)		Ammonia		Cellulose	
		U mol/g dry content	total (U mol)	U g/g dry content	total (Ug)	% of total content	total amount (g)
Roughage ⁽¹⁾	Stomach	50.0	360.0	255	1836.0	18.63	1.34
	S.intestine	130.0	96.2	272	201.3	27.52	0.20
	cecum	260.0	2744.0	272	2665.6	18.36	1.80
	colon	78.1	117.2	743	1114.5	21.19	0.32
Concentrate ⁽²⁾	Stomach	87.5	957.7	4600	51120	17.3	2.14
	S.intestine	114.3	258.8	6800	17000	11.3	0.28
	Cecum	220.5	1830.0	1890	15687	13.9	1.15
	Colon	1000.0	1800.0	11900	21420	21.5	0.39

II — *The in vitro digestion abilities of the cecum contents of the rabbits*

The *in vitro* VFA production from various roughages behaved differently from that of the *in vitro* cellulose digestion in these roughages. It is noted that the maximal levels of VFA in the three tested roughages were obtained at 12 hr after incubation as shown in the following chart :

Sources of cellulose	Time (hrs) after incubation		
	3	6	12
Berseem hay	636.5	1272.5	2281.5
wheat straw	818.0	1000.0	1363.5
cellulose of wood	363.5	1272.5	1272.5

1- Cellulose digestion was judged by VFA production.

2- Values of total VFA are expressed as U mol/gm dry content of cecum.

It is obvious that the increased levels of starch have depressed significantly the cellulose digestion by the rabbit cecal contents.

It is obvious that most of the ammonia released as the result of hydrolysis of different proteins (Casein, blood meal and cottonseed meal) was obtained at 6 hr and the highest production of ammonia and VFA was obtained from blood meal. Similarly, the VFA released from cottonseed meal was higher than that resulting from casein fermentation. The addition of increased levels of urea to the fermentation tubes containing cecal contents showed that the sharp rise in ammonia was noted at 6 hr after incubation in the high level, whereas in the low and medium levels of added urea, this rise was observed at 12 hr after incubation. The maximal increase in VFA production in response to the addition of urea has occurred at 6 hr of incubation. Also the addition of low and high levels of starch has encouraged the ammonia production from urea at 6 hr after incubation.

The amount of microbial protein formed when cecal contents of rabbits were incubated with urea or urea plus starch during 12 hr. The addition of starch has improved the abilities of cecal microorganisms to convert urea into microbial protein.

III — Urea as a supplement in the diets of rabbits

A sharp and statistically significant increase in the blood urea-N was noted in response to the addition of urea in the ration of rabbits at 4 weeks after feeding. Thereafter a significant decrease was observed at 10 weeks after feeding with urea at the rate of 1% of the ration were lower than those rate of 3% of the diet. A decrease in the total numbers of cecal microorganisms was observed when urea was included at the level of 1% of the diet of rabbits whereas no significant change in the microbial population was noted when urea added at the rate of 3%.

Significant differences in the feed intake were observed in response to the supplementation of the diet with two levels of urea. The change in body weights and daily gains of rabbits fed on the control diet and those given two levels of urea to replace a part of all of the cottonseed cake in this diet are shown in the following chart (Daily gain/g).

Weeks after treatment	Control (Rabbits receiving no urea) (g)	Treated animals	
		1% urea (g)	3% urea (g)
2	13.30	14.90	11.60
4	14.55	13.75	9.55
6	16.05	11.70	11.55
8	12.40	10.90	11.20
10	9.45	9.95	13.25
Average	13.15 ± 0.87	12.24 ± 0.68	11.52 ± 0.66

However, the differences between the three groups of rabbits in regard to the daily gain were not statistically significant. The feed efficiency became inferior as the animals grew older. Data suggest that adding increased levels of urea of the diets of rabbits in order to replace a part or all of cottonseed cake, has no adverse

effect on these animals. Similar results were reported by Bruggemann and Giesecke (1967), McLaren (1964) and Ewan *et al.* (1958).

This work leads to the conclusion that the rabbit is a ruminant like animals and is different from the rat in regard to NPN metabolism (Chas and Torver, 1953).

References

- Abou-Akkada, A.R. and El-Shazly, K. (1964) Effect of absence of ciliate protozoa from the rumen on microbial activity and growth of lambs. *Applied Microbiology* 12, 384.
- Abou-Akkada, A.R. and Osman, E. El-Sayed (1967) The use of ruminal ammonia and blood urea as a index of the nutritive value of protein in some foodstuffs. *J. Agric. Sci.* 69, 25.
- A.O.A.O. (1960) «Official Methods of Analysis» (9th Ed.) Association of Official Agriculture Chemists, Washington, D.C.
- Barakat, M.A. (1976) The use of non protein nitrogenous compounds in Rabbits Rations. M. Sc. Thesis, Fac. Agric., Univ. of Monofia, Egypt.
- Bruggemann, J. and Giesecke, D. (1967) The effect of urea on rumen microbiology and metabolism. P.P. 125. In «Urea as a Protein Supplement». Ed. N.H. Briggs. Pergamon Press, London and New York.
- Chas, F.C. and Torver, H. (1953) Cited by Houpt, T.R., 1963 From *Am. J. Physiol.* 205, 1144.
- Crampton, E.W. and Maynard, L.A. (1938) The relation of cellulose and lignin content to the nutritive value of animal feeds. *J. Nutr.* 15, 383.
- Ewan, R.C., Hatfield, E.E. and Carrigus, U.S. (1958) The effect of certain incubation on the utilization of urea or biuret by growing lambs. *J. Anim. Sci.* 17, 298, 303.
- Hoover, W.H. and Holtonam, R.N. (1972) Effect of dietary fiber levels on weight gain, cecal volume and volatile fatty acid production in rabbits. *J. Nutrition*, 103, 375.
- McLaren, C.A. (1964) Symposium on microbial digestion in ruminant : nitrogen metabolism in the rumen. *J. Anim. Sci.* 23, 577.

- Snedecor, G.W. (1956) «Statistical Methods Applied to Experiments in Agriculture and Biology». 5th Ed. The IOWA State College Press, Ames.
- Susan, J. Henning and Hiro, F.J.R. (1972) Diurnal variations in the concentrations of volatile fatty acids in the alimentary tract of wild rabbits. *The British Journal of Nutrition*, 27, 57.
- Yoshida, T., Pleasaunts, J.R., Reddy, B.S. and Wastmann, B.S. (1968) Efficiency of digestion in germ free and conventional rabbits. *Br. J. Nut.* 22, 723.

تأثير اضافة اليوريا لتحل محل جزء من البروتين النباتي لعلائق الارانب

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اجريت بعض التجارب لدراسة طبيعة ونشاط محتوى الاعور فى الارانب خاصة الاستفادة من اضافة اليوريا للعليقة . وقد تمت الدراسة على جزئين احدهما معمليا *In vitro* واخر دراسات تغذية على الارانب .

وكانت من نتائج الدراسة العملية الخاصة بالتحليل الكيماوى الكامل المحتوى الجهاز الهضمى وخاصة انتاج الاحماض الدهنية الطيارة وان الاعور هو اعلى اجزاء القناة الهضمية للارانب تخمرا وكانت قدرة الاعور على هضم السليلوز وانتاج الاحماض الدهنية الطيارة عالية وقلت هذه القدرة عند اضافة النشا حيث قل هضم السليلوز - وقد دل تواجد وانتاج الامونيا والاحماض الدهنية الطيارة على وجود نشاط لمحتوى الاعور على المصادر المختلفة للبروتين وايضا ثبت وجود انزيم اليوريز فى مكونات الاعور وهذا الانزيم ادى الى تحليل اليوريا الى امونيا تحول جزء منها الى بروتين بكتيرى فى خلايا الاحياء الدقيقة فى الاعور بعد ١٢ ساعة من اضافة اليوريا والتحصين .

اما دراسة التغذية التى اجريت على الارانب فكانت نتائجها بعد عشرة اسابيع كالآتى :-

- (١) اضافة اليوريا عند مستوى ١٪ ادت الى نقص المدد الكلى للبكتريا فى الاعور فى حين لم يحدث تغير يذكر عند مستوى ٣٪ .
- (٢) اضافة اليوريا الى علائق الارانب ادى الى ارتفاع مستوى اليوريا فى الدم ثم انخفض هذا المستوى انخفاضا ملحوظا بعد ٦ اسابيع من التغذية على العلائق المحتوية على يوريا .
- (٣) تغذية الارانب على اليوريا بدلا من بعض او كل كسب القطن لم تؤثر فى كمية الاكل او معدل النمو او الكفاءة الغذائية فى الحيوانات المعاملة خلال فترة التجربة .