

## **DEVELOPMENT OF FEEDING STRATEGY FOR RUMINANT LIVESTOCK BY NUCLEAR TECHNIQUES**

*Ozcan H., Çetinkaya N.*

Turkish Atomic Energy Authority ,Ankara Nuclear Research Center in Agriculture  
and Animal Sciences, Saray, Ankara, Turkey

### **Abstract**

In tropical and subtropical areas crop residues and agro-industrial by-products are used for feeding ruminant livestock under limited or zero grazing conditions. In order to increase feeding efficiency and livestock productivity supplementations are essential to meet deficient nutrients for diets. For the assessment of the impact by supplementation or supplements by various nitrogen sources together with salts and minerals upon energy utilisation C-14 labelled acetate was used for tracer to measure outflow rates of volatile fatty acids (VFAs) from rumen by Angora goat bucks. The supplemented diets led to increased VFAs outflow rates from rumen. The conclusion was that ruminant diets consisted by crop residues and agro-industrial by-products need supplementations for deficient nutrients to increase efficiency of feed energy utilisation by ruminant livestock. The impact upon VFAs production by supplementation was assessed easily by nuclear technique.

### **1. Introduction**

In order to increase productivity from ruminant livestock fed crop residues and agro-industrial by-products, dietary supplementation plays critical roles. The type and amount of supplementation depends upon the availability and quality of forages or roughages used. When low quality crop residues like straws are used for feeding, supplementation by feeds or feedstuffs like beet pulp, crushed barley and molasses for easily fermentible energy and oil seed meals or urea for fermentible nitrogen and several minerals are required to meet the nutrient needs for both rumen microbes and the animals.

To demonstrate the effects by dietary supplementation upon certain ruminal parameters nuclear techniques like isotope dilution method are unique. For the purpose the isotope dilution method by either single injections or infusion with H-3 and C-14 labelled VFA or VFAs solutions are used.

The objective of the study was to assess the impacts or improvements made by dietary supplementation with different nitrogen sources together with salts and minerals upon feed energy utilisation by isotope dilution method by single injections.

## **2. Materials and Methods**

### Animals, feeds, diets and methods

Three Angora goat bucks, each equipped with a rumen canula were used in the experiments. A basic diet was prepared from low quality grass hays, beet pulp, molasses and wheat bran (Table. 1 and 2). Two supplemented diets were prepared either by adding urea or sunflower meals into the basic diet together with aqual amounts of salts and minerals (Table 1).

**Table 1. Diets**

	<b>ME(MJ/kg DM)</b>	<b>CP(g/kg DM)</b>
1. Basic diet	10.5	112
2. Supplemented diet A	10.3	135
3. Supplemented diet B	10.8	139

**Basic diet (kg/ton):Beet pulp 500, Grass hay 300, Wheat bran 150, Molasses 50**

Supplemented diet A: Basic diet +Urea(1) + Salts and Minerals(3)

Supplemented diet B: Basic diet +Sunflower meals(2) + Salts and Minerals(3)

(1):Urea 10 kg/ton; NaSO<sub>4</sub> 1 kg/ton

(2):Sunflower meals 70 kg/ton

(3): Salt 5 kg/ton; Dicalcium phosphate 5.8 kg/ton; Copper sulphate (5H<sub>2</sub>O)15 g/ton; Manganese sulphate(7 H<sub>2</sub>O) 46 g/ton; Zinc sulphate(7H<sub>2</sub>O) 90 g/ton; FeCL<sub>3</sub>(6H<sub>2</sub>O) 108 g/ton

**Table 2. Chemical composition of dietary ingredients (g/kg; dry matter basis)**

<b>Ingredients</b>	<b>DM</b>	<b>OM</b>	<b>CP</b>	<b>NDF</b>
Beet pulp	122	936	130	785
Grass hays	919	916	69	695
Wheat bran	882	965	158	479
Molasses	717	888	80	-

A 3x3 experimental design was used for samplings. Before each sampling period, feeding was lasted for two weeks.

For sampling, each animal was given by single injections of 50 mls solutions into rumen from a stock solution containing 1 mCi C-14 acetate per liter. Samples of 25-30 mls ruminal fluid were collected by hourly intervals for 7 hours following each injection.

Samples of ruminal fluid collected were analysed for ammonia and VFAs concentrations by Markham method (1).

Radioactivity was determined by beta-counting (Packard, Tri-Carb 1550) after isolating VFAs from rumen fluid by Markham steam distillation.

Values of pH for rumen fluid samples were recorded by using a pH meter.

### 3. Results and Conclusion

Improvements by dietary supplementation were easily assessed by isotope dilution method by single injections into rumen (Table 3)

**Table 3. Effects of dietary supplementation by urea or sunflower meals together with salts and minerals upon certain ruminal parameters**

<b>Parameters</b>	<b>Basic Diet</b>	<b>Suppl. diet A</b>	<b>Suppl. diet B</b>	<b>SE</b>
Ruminal fluid total VFAs concentration (mmoles/liter)	111	90	109	5
Ruminal fluid volume(liters)	3.9	6.2	6.6	0.8
Outflow rates for VFAs from rumen (hour <sup>-1</sup> )	0.30	0.34	0.35	0.03
Ruminal pool sizes for VFAs (mmoles)	446	564	642	103
Daily outflow rates for VFAs (moles/d)	3.2	4.6	5.5	0.9

When compared to the results obtained by basic diet, supplementing basic diet with urea or sunflower meals together with salts and minerals improved rumen conditions related to feed energy utilisation like VFAs outflow rates, pool sizes of VFAs and daily VFAs productions (Table. 3). This also increased fluid volumes in the rumen (Table. 3).

With inclusion of urea into diets together with salts and minerals, higher rumen fluid ammonia concentrations and pH values were found (Table 4 and 5). This was also consistent with lower rumen fluid VFAs concentrations (Table. 6). Supplementation with sunflower meals ,salts and minerals also increased fluid

volume in the rumen, VFAs outflow rates from rumen, ruminal pool size of VFAs and daily VFAs productions (Table. 3).

The VFAs concentrations in ruminal fluid were not directly related to the daily VFAs productions.

In conclusion, under zero grazing and when low quality roughages and agro-industrial by-products are used for feeding ruminants, proper supplementations are crucial for increasing feed utilisation efficiency. This was easily demonstrated by isotope dilution method.

**Table. 4. Ruminal fluid ammonia concentrations. (n=3)**

Diets	Sampling time(hours after injections)							
	0	1	2	3	4	5	6	7
Basic	117	118	110	126	112	102	82	107
Suppl.A	305	289	207	206	199	196	187	223
Suppl.B	382	324	284	313	116	200	267	165
SE	108	13	83	36	43	41	13	24

**Table. 5. Ruminal fluid pH values(n=3).**

Diets	Sampling time(hours after injections)							
	0	1	2	3	4	5	6	7
Basic	5.9	5.8	5.8	5.8	5.9	5.9	5.9	5.9
Suppl.A	6.2	6.2	6.2	6.1	6.1	6.0	6.1	6.1
Suppl.B	5.6	5.7	5.7	5.7	5.6	5.7	5.6	5.6
SE	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2

**Table. 6. Ruminal fluid VFAs concentrations (mmoles/liter)(n=3).**

Diets	Sampling time(hours after injections)							
	0	1	2	3	4	5	6	7
Basic	120	111	110	111	114	113	111	97
Suppl.A	96	90	88	94	81	89	87	97
Suppl.B	119	119	108	105	103	108	105	106
SE	7	4	13	7	10	4	1	7

Acknowledgements: The authors would like to thank Turkish Atomic Energy Authority (TAEK) for technical and financial support.

#### References

1. Markham, R. A steam distillation apparatus suitable for Micro-Kjeldahl analysis. *Biochem. J.* 36:790, 1942.