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THE USE OF DPW AT VARYING LEVELS IN CATTLE FATTENING RATIONS

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OPSOMMING: DIE GEBRUIK VAN VERSKILLENDE PEILE VAN DHM IN BEESVETMESTINGSRANTSOENE

4 Peile (0%, 4%, 8%, en 12% op 'n droë basis) gedroogde battery lêhennemis (DHM) is tesame met òf ureum òf sonneblomoliekoekmeel gevoer om vas te stel of lae peile van DHM met sukses in beesvetmestingsrantsoene aangewend kan word. 88 Speenouderdom osse, waarvan 8 in die begin geslag is as maatstaf van die aanvanklike karkasmassa, is in 'n 4 x 2 faktoriale rangskikking gebruik. Die resultate toon dat daar geen betekenisvolle verskille in massatoenames was tussen die beeste wat òf ureum òf sonneblomoliekoekmeel as bron van proteïen ontvang het nie. Die inskakeling van DHM het onderdrukking in diereproduksie tot gevolg gehad, hoewel slegs die 12% peil van DHM insluiting massatoenames statisties betekenisvol (P < 0,01) beïnvloed het. As gevolg van die laer rantsoenkoste was die insluiting van DHM, in plaas van sonneblomoliekoekmeel, selfs tot by die 12% peil van inskakeling teen heersende pryse ekonomies geregverdig.

SUMMARY:

4 Levels (0%, 4%, 8%, en 12% on a dry matter basis) of dried cage layer manure (DPW) were combined with either urea or sunflower oilcake meal to investigate the possibility of successfully including low levels of DPW into cattle fattening rations. 88 Weaner steers were used in this 4 x 2 factorial study, 8 of which were slaughtered at the start of the trial in order that the initial carcass mass of the remaining animals could be estimated. When the main effects of urea and sunflower oilcake meal were compared, no significant differences in animal performance rates were evident. The inclusion of DPW resulted in a depression in animal performance, although this depression was only significant (P < 0,01) at the 12% level. Due to the lower ration costs the use of DPW, in place of sunflower oilcake meal, was economically justified at present prices even at the 12% level of inclusion.

The rising cost of protein as well as the pollution hazards involved in disposing of animal wastes has resulted in increased attention being paid over the years to the recycling of poultry waste products. In 1955 Noland, Ford & Ray conducted experiments aimed at evaluating chicken litter as a source of nitrogen in ruminant diets and since then much work has been devoted to this subject as is evident from the review by Bhattacharya & Taylor (1975).

Farmers in Southern Africa have, during the past 2 decades, been using ever increasing tonnages of poultry litter as a supplementary feed and as an ingredient in ruminant production diets, but the use of droppings from caged layers has been less popular, probably because of its high moisture content and its associated handling problems. This constraint can be overcome by drying the product and, at the same time, rendering it completely safe and free of pathogenic micro-organisms. This is in fact being done at one plant in Southern Africa which, for the last 6 years, has produced dried caged poultry layer manure (DPW) which is now officially approved for inclusion in animal feeds. This product is at the moment being used in both ruminant and poultry rations. It is, however, in ruminant feeding that DPW can be utilised more completely, as only ruminants are able to make effective use of the NPN contained in DPW.

Assuming that each laying hen excretes 28 g of dry matter (Smith, 1974), South Africa could have at its disposal a potential 90 000 tons of dry DPW if all caged layer manure were taken into account, which would substantially reduce the reliance on conventional protein sources. Information is thus necessary on guidelines on the practical use of DPW in ruminant rations, as relatively little research work has been devoted to evaluating this product in Southern Africa.

The results of overseas research work on the inclusion of DPW in production rations for ruminants have, in general, been favourable. Work by Bucholtz, Henderson, Thomas & Zindel (1971) and Cullinson, McCampell, Cunningham, Lowrey, Warren, McLendon & Sherwood (1976), and confirmed by Kargaard & Van Niekerk (1977), however, showed that animal performance was depressed with the inclusion of DPW. Previous work by the authors had involved relatively high levels of DPW inclusion in feedlot rations. In order to establish if lower levels of inclusion might not give more favourable results, it was decided to investigate the effects of including DPW, at 4 different dietary levels, on the performance of feedlot cattle. This was done by means of a 4 x 2 factorial arrangement testing 4 levels of DPW in combination with either sunflower oilcake meal (a natural protein source), or urea (an NPN source).

Procedure

Experimental animals

88 Hereford x Afrikander crossbred weaner steers were used in this trial.

Initial slaughter group

The 88 steers were restrictively randomised according to initial body mass, into 11 groups of 8 animals each. One of these groups was selected at random to serve as an initial slaughter group. The average dressing percentage of this group was then used to estimate the initial carcass mass of each of the 80 experimental steers.

Experimental design

The remaining 80 animals were divided again by restrictive randomisation, according to initial body mass, into 8 groups of 10 animals to form a 2 x 4 factorial arrangement.

Treatments

The composition of the 8 experimental rations appear in Table 1.

4 Levels of DPW, viz. 0%, 4%, 8% and 12%, were combined with either urea or sunflower oilcake meal to supply all the supplementary protein required. The DPW was obtained from caged layers, the droppings being collected and dried as previously described by Kargaard & Van Niekerk (1977). All the rations were isonitrogenous and isocaloric, and were formulated to meet the minimum requirements for crude protein (12,20%), calcium (0,46%) and phosphorus (0,34%), expressed on a dry matter basis, as recommended by the NRC (1971). In the rations containing DPW, calcium and phosphorus exceeded these minimum requirements, due to the high levels of these 2 elements in DPW. A constant level of 15% dried sugar cane bagasse pith pellets acted as the roughage component, whilst maize bran was used to

Table 1

Percentage composition of the 8 experimental rations (dry matter basis)

Protein source	Urea				Sunflower			
DPW* Levels	0%	4%	8%	12%	0%	4%	8%	12%
Ration	1	2	3	4	5	6	7	8
Maize meal	62,72	64,14	64,87	65,20	63,65	65,50	67,00	68,50
Bagasse pith pellets	15,00	15,00	15,00	15,00	15,00	15,00	15,00	15,00
Maize bran	19,00	15,00	11,00	7,00	7,00	5,30	2,70	–
Urea	1,53	1,16	0,83	0,50	–	–	–	–
DPW*	–	4,00	8,00	12,00	–	4,00	8,00	12,00
Limestone	0,70	0,10	–	–	0,90	0,10	–	–
Monocalcium phosphate	0,75	0,30	–	–	0,15		–	–
Sunflower oilcake meal	–	–	–	–	13,00	9,80	7,00	4,20
Salt	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30

* DPW – dehydrated caged layer manure

Table 2

The chemical composition and energy value of the raw materials used (Dry matter basis)

	Dry matter basis					
	Moisture (%)	Crude protein (%)	Crude fibre (%)	Calcium (%)	Phosphorus (%)	NEg (MJ/kg)
Yellow maize meal	11,70	9,17	2,60	0,02	0,25	6,19
Maize bran	13,80	9,60	11,90	0,10	0,41	4,19
Bagasse pith pellets	6,00	2,00	38,50	0,20	–	0,84
Sunflower oilcake meal	9,60	42,00	16,20	0,40	1,20	3,47
Urea	–	287,00	–	–	–	–
Limestone	–	–	–	36,00	–	–
Monocalcium phosphate	–	–	–	22,00	21,00	–
DPW*	12,30	32,00	13,80	8,46	2,09	2,93

* DPW – dehydrated caged layer manure.

equalize the crude fibre (10,0%) and NEg (4,83 MJ/kg) contents. The raw materials were analysed for the major nutrients concerned (Table 2), whilst NEg values for maize and sunflower oilcake meal were obtained from the NRC (1971) tables. In the case of maize bran, dried sugar cane bagasse pith and DPW, the values given by Kargaard & Van Niekerk (1977) were used. Flavomycin was added to all rations, as a growth promotor, in quantities sufficient to ensure a daily intake of 30 mg of active ingredient per head.

Parameters measured

Animals were weighed every fortnight. Initial and final body mass was determined after a 15-hour fast, whilst all other mass determinations were on full stomachs. Cold carcass mass and dressing percentage was determined after slaughter. Feed conversion rates are based on average group feed intakes. Animals were slaughtered when the average live body mass of the group reached approximately 340 kg. This was done to minimise the variation in the average final body composition between the various experimental groups.

Results

Feed analysis

The mean chemical composition of the 8 experimental rations, based on representative samples of the diets fed, appear in Table 3. Little variation was noted between rations in respect of the nutrients analysed, excepting, as expected, the calcium and phosphorus levels tended to be slightly higher at the higher DPW inclusion rates. The sunflower oilcake meal diets (Rations 5, 6, 7 and 8) also appeared to contain slightly higher levels of crude fibre.

Initial slaughter group

The average dressing percentage of the 8 animals slaughtered at the beginning of the trial was 53,11 ± 1,41%. This figure of 53,11% was used to estimate the initial carcass mass of each of the experimental animals.

Statistical analysis

An analysis of variance carried out on the experimental data showed no interactions between the two factors under test. For this reason it was possible to investigate the main effects of varying DPW levels as well as the inclusion of urea or sunflower oilcake meal as the main supplementary protein source.

Main supplementary protein sources

It is evident from Table 4 that urea resulted in a slightly superior rate of livemass gain and improved livemass feed conversion rate but because of the slightly lower dressing percentage the rate of carcass feed conversion on urea was poorer. However, none of these differences were large enough to approach statistical significance.

DPW levels

The effects on animal performance due to the inclusion of DPW is summarised in Table 5. A highly significant decrease was observed in mass gains with the inclusion of 12% DPW. Although the differences between the other groups were statistically non-significant, there was nevertheless a trend for increasing levels of DPW to cause an increasing depression in the live mass gain. Carcass mass gains followed a similar trend, except at the 4% DPW level where the gains were identical to the DPW-free group. Feed intake of the groups which received DPW in their diet was similar, but was slightly higher than that of the groups fed DPW-free diets. A downward trend was noted in feed conversion rate as the level of DPW increased.

Table 3

The mean chemical analysis of the eight experimental rations (Dry matter basis)

Ration	Dry matter (%)	Dry matter basis				
		Crude protein (%)	Crude fibre (%)	Ether extract (%)	Calcium (%)	Phosphorus (%)
1	87,7	12,2	9,8	4,5	0,47	0,35
2	90,0	12,3	9,5	4,3	0,50	0,38
3	89,6	12,3	9,6	4,0	0,51	0,39
4	89,4	12,5	9,4	4,3	0,56	0,40
5	90,1	12,2	10,5	4,6	0,46	0,36
6	89,8	12,2	10,1	4,6	0,48	0,38
7	89,9	12,4	10,9	4,3	0,49	0.41
8	87,9	12,4	10,4	4,0	0,51	0,41

Table 4

Main effects of including either urea or sunflower oilcake meal as supplementary protein sources

Protein source		Urea	Sunflower
Number of animals		40	40
Days to slaughter		115	115
Initial live mass	(kg)	197,6	196,2
Final live mass	(kg)	340,6	337,0
Daily live mass gain	(kg)	1,24 ± 0,19	1,23 ± 0,16
Initial carcass mass	(kg)	104,9	104,2
Final carcass mass	(kg)	188,2	187,9
Daily carcass mass gain	(kg)	0,72 ± 0,09	0,73 ± 0,08
Dressing percentage	(%)	55,23 ± 1,52	55,77 ± 1,46
Feed intake (DM basis)	(kg)	7,32	7,33
Kg feed (DM)/kg live mass gain		5,90	5,96
Kg feed (DM)/kg carcass mass gain		10,17	10,04

Table 5

Main effects of DPW on animal performance*

Levels of DPW		0%	4%	8%	12%
Number of animals		20	20	20	20
Days to slaughter		112	115	115	119
Initial live mass	(kg)	196,8	196,8	197,3	196,8
Final live mass	(kg)	338,9	341,0	339,0	336,1
Daily live mass gain	(kg)	1,27 ± 0,15	1,25 ± 0,16	1,23 ± 0,19	1,17 ± 0,16
Estimated initial carcass mass	(kg)	104,5	104,5	104,8	104,5
Final carcass mass	(kg)	187,3	189,4	189,0	186,4
Daily carcass mass gain	(kg)	0,74 ± 0,10	0,74 ± 0,11	0,73 ± 0,12	0,69 ± 0,10
Dressing percentage	(%)	55,27 ± 1,13	55,53 ± 1,44	55,73 ± 1,55	55,44 ± 1,58
Feed intake (DM basis)	(kg)	7,08	7,48	7,41	7,33
Kg feed (DM)/kg live mass gain		5,57	5,98	6,02	6,26
Kg feed (DM)/kg carcass mass gain		9,57	10,10	10,15	10,62

* DPW – dried caged layer manure

Discussion

In production rations there is often a tendency for natural protein sources such as sunflower oilcake meal to give superior rates of livemass gain. In this trial, however, virtually no differences were recorded in animal performance between cattle on sunflower oilcake meal or urea. This could well partly be due to the fact that the steers concerned were over-wintered on a urea-containing lick, and had thus become completely adapted to urea and were therefore not hampered by the normal urea adaption period upon entering into the feedlot. A further reason for the similar performance observed by the animals on urea and sunflower oilcake meal could be that Flavomycin was added to all rations as a growth promotor. In a previous unpublished trial by the authors it was found that Flavomycin showed a more pronounced, although not significant, positive response with urea when compared to sunflower oilcake meal. It could well be that the same trend was applicable in this trial, and that Flavomycin helped to narrow the difference sometimes observed between urea and sunflower as protein sources in ruminant fattening rations.

A downward trend was noted in animal performance as the level of DPW increased. It was, however, only at the 12% level that both live and carcass mass gains were significantly ($P < 0,01$) affected. In terms of average daily carcass gain, this amounted to a depression of 7% compared to the DPW-free treatment. This is somewhat less than the depressions found by the authors in other studies (Kargaard & Van Niekerk, 1977; unpublished data). A possible explanation for this was referred to by Kargaard & Van Niekerk (1977), who pointed out that the poor performance of animals on DPW was aggravated when molasses was included in the ration as well, due possibly to an adverse mineral interaction, as both these products have a high ash content.

In the present trial, and contrary to the two others referred to, no molasses was added, which tends to confirm this theory. The routine inclusion of Flavomycin to all diets in the present experiment could possibly also have exerted some beneficial effect on DPW utilization.

In contrast to the authors' previous study (Kargaard & Van Niekerk, 1977), and other research work (Bucholtz *et al.,* 1971; and Tinnimit, Yu, McGuffey & Thomas, 1972), the inclusion of DPW did not depress feed intake. In fact, feed intake in the present trial was slightly higher on rations containing DPW which is in agreement with studies by Cullison *et al.,* (1976) and unpublished work by Voges & Van Niekerk (1975). The poorer performance of animals fed DPW in this trial can therefore not be attributed to a lower feed intake. It is possible, however, that the net energy value for DPW may be lower than the level used in balancing the experimented rations. Should this be the case, the rations would not be isocaloric as was assumed to be the case. The possibility of an adverse mineral balance, as previously suggested (Kargaard & Van Niekerk, 1977), can also not be ruled out. Of significance in this respect was the obviously higher urine output of the DPW-fed animals as was evident from the fact that the pens in which these animals were kept were always much wetter than those of the animals fed the DPW-free rations.

An economic evaluation of the results, based on ruling feed prices, shows that the slightly poorer feed conversion rates measured on urea as against sunflower oilcake meal was more than compensated for by the lower cost of the urea rations. It is also evident that although the inclusion of DPW tends to depress animal performance, the saving in ration costs is such that even at the 12% level of inclusion, the use of DPW at R40/ton is still economically justified when compared with sunflower oilcake meal.

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