

Effect of Combining Yam Peels with Cowpea Husk on Nitrogen Metabolism and Serum Biochemical Parameters of Dwarf Bucks

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Abstract

The study was conducted to investigate the effect of combining yam peels with cowpea husk, using nitrogen metabolism and serum biochemical parameters by West African dwarf male goats (bucks). Twenty four dwarf bucks with means weight of 7.00 ± 0.25 kg and aged between 7 and 8 months old were randomly assigned to three dietary treatments in a completely randomized design with eight bucks per treatment. The compared diets which comprised different proportions of yam peels and cowpea husk respectively were: Diet I (65.00 and 10.00%) Diet II (60.00 and 15.00%) and Diet III (55.00 and 20.00%). Results obtained showed that Diet I was significantly ($P < 0.05$) highest in serum urea (30.04mg/dl), calcium (2.06mmol/L) and phosphorous 92.43mmol/L compared to other Diets, while Diet II was best in serum cholesterol (73.86 mg/dl). Nitrogen intake 910.00g/day), urinary nitrogen output (1.09g/day), total nitrogen output (3.38g/day), nitrogen absorbed in g/day and g/day/BW^{0.75} (6.62 and 4.13), nitrogen retention and digestibility (66.20 and 77.11%), serum total protein (8.05g/dl), albumin (3.43g/dl), globulin (4.62g/l) and blood glucose (4.01mmol/L) were highest in diet III and significantly ($P < 0.05$) differed from the other diets. Significant difference ($P > 0.05$) did not occur in faecal nitrogen output (g/day) and serum creatinine (mg/dl). It is concluded that combination of yam peels and cowpea husk in diet III enhanced nitrogen metabolism and serum biochemical indices of dwarf bucks.

Keywords: Nitrogen, serum biochemistry, yam peels, cowpea husk, bucks.

Introduction

Small ruminants form the major group of ruminants' species in livestock industry in the tropics. They are widely distributed in the tropics and sub-tropics, where they play a significant role in the nation economy. Goat is a multi-functional animal that constitute a very important part of the livelihood of livestock farmers in Nigeria (Okoruwa *et al.*, 2013a). They also offers the cheapest source of domestically provides meat in the tropics because of their fecundity and low feed requirement when compare to cattle and sheep (Tsado *et al.*, 2009). The potential of goat production in alleviating the problem of low animal protein intake by man in developing nations like Nigeria has long been noted by some workers (Tsado *et al.*, 2009; Adeokun *et al.*, 2008). Despite the world-wide importance of goats as providers of essential meat and diary products (Stella *et al.*, 2007), low animal protein intake still remain one of the major human nutritional problem in Nigeria especially for the low income earners. Inadequate nutrition is one of the major factors contributing to the insufficiency in goat production. Numerous researchers' data indicated that low productivity of goats in Nigeria (Wiziri *et al.*, 2010 ; Okoruwa *et al.*, 2013a) is associated with problems of meeting their nutritional requirements. This is aggravated by seasonal fluctuation that affects the nutritive quality of nature pasture most especially during the dry season and the steady increase in prices of feed ingredients due to competition between man and livestock.

The use of agro-industrial by-products has been identified to contributes a vital role in the nutrition of ruminant livestock and ensure all year round availability of feeds for animals. Yam (*Dioscorea* spp) is a primary staple food for people in Africa. Ruminant can be fed on yam peels obtained after processing yam for food. Facts reported in literature shown that yam peels have high potential as energy source which when fortified with nitrogen promote positive and high performance levels in ruminants (Abara, 2011). Cowpea (*Vigna unguiculata*) husk is a potential supplementary feed for ruminant in the dry season. It is likely to have higher crude protein than yam peels and may thus improve utilization of yams peels if they combine them as feeds for ruminants. Okoruwa *et al.* (2013b) reported that problem of using by-products as feeds for ruminants can be minimise or tackle, if they are used at the right proportions. However, the combinations of yam peels with cowpea husk are jet to gain much attention in goat nutrition. Hence, the objective of the present study was to determine the effect of combining yam peels with cowpea husk on nitrogen metabolism and serum biochemical indices of dwarf bucks.

Materials and Methods

Location Site: The experiment was carried out at the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Nigeria. The mean annual rainfall of the location was about 1556mm, while the minimum and maximum temperature were about 26°C and 34°C respectively. The vegetation represents an interface between the tropical rainforest and the derived savannah.

Experimental Diets: Guinea grass was harvested from the pasture land and fallow land within the Teaching and

Research Farm premises. The guinea grass was allowed to wilt before being chopped manually to about 6 to 7cm. Yam peels and cowpea husk were collected from their processing centre within Ekpoma sun-dried, crushed and kept in an airtight bags separately till the period of usage.

Guinea grass was fed as basal diet for all the bucks while combination of yam peels and cowpea husk at various inclusion levels with concentrate supplement were used as the experimental diets. The composition of the concentrate supplement was as follows: wheat offal 12.00%, brewers dry grain 9.00%, bone meal 1.75%, salt 1.25% and vitamin 1.00%. However, the three experimental diets that were formulated and designated were:

Diet I = 65.00% yam peels + 10.00% cowpea husk + 25.00% concentrate supplement

Diet II = 60.00% yam peels + 15.00% cowpea husk + 25.00% concentrate supplement

Diet III = 55.00% yam peels + 20.00% cowpea husk + 25.00% concentrate supplement

Management and Feeding of Bucks: Twenty four growing West African dwarf male goats (bucks) with an average body weight of 7.00 ± 0.25 kg and aged between 7 and 8 months old were used for the experiment. The bucks were sourced from weekly sheep and goat market located within Ekpoma. At the commencement of the experiment the bucks were given prophylactic antibiotic to fight against ecto and endo parasites while ivomec injection was administered to control micro-organism infections. The bucks were housed in demarcated individual pens with concreted floor and dwarf wall.

Completely randomized design was adopted for the experiment in which the bucks were divided into three groups of eight bucks each after balancing for weight and each group was randomly allocated to one of the three dietary treatments. The basal and the experimental diets were fed to bucks once daily in equal ratio of 50:50 respectively, at the rate of 5% (DM basis) of their body weight. The weighed experimental diets were offered every morning (8.00am) followed by the guinea grass on exhaustion of the diets. Drinking water was also provided *ad libitum*. Moreover, the trial lasted for 84 days comprising of 20 day adjustment period and 14 days of metabolic study.

Nitrogen Metabolism Trial: Six bucks per treatment (totalling 18) were selected and randomly allocated to individual metabolic cages designed for separate collection of faeces and urine. Nitrogen metabolism trial was carried out in the last 7 day feeding regime after 7 day adjustment period.

The quantity of feed offered and feed refusal which represented the fraction of the quantity of the feed offered to each buck per day that was not consumed were weighed daily. The weight difference between them was recorded and taken as the feed intake. Daily faecal sub-samples were weighed, oven dried, bulked together and stored until needed for analysis. 20 ml of daily urine samples from each buck were collected in sample bottles containing concentrated sulphuric acid and frozen until required for analysis.

Nitrogen absorbed by the bucks were calculated as the difference between nitrogen intake and nitrogen excreted from faeces and urine while nitrogen retention percentage were computed from nitrogen balance expressed as a percentage of nitrogen intake. Apparent nitrogen digestibility was calculated using this formula:

$$\text{Apparent nitrogen digestibility} = \frac{\text{nitrogen intake} - \text{nitrogen in faeces}}{\text{nitrogen intake}} \times \frac{100}{1}$$

Serum Biochemical Study: On the last day of an 84 day experimental feeding trial period, 5ml of blood sample was taken from all the bucks through jugular venipuncture using a 10ml 20 gauge syringe. The blood sample was collected into anti-coagulant free plastic tubes and allowed to coagulate at room temperature and centrifuged for 10 minutes at 300rpm. The supernatant sera were then stored in a freezer for subsequent biochemical analysis.

Biochemical constituents of the serum samples estimated included total protein, albumin, globulin, cholesterol, creatinine, urea, glucose, calcium and phosphorous as described by Waziri *et al.* (2010).

Chemical and Statistical Analyses: AOAC (2002) methods were used for the determination of proximate composition of the experimental diets, guinea grass as well as nitrogen content of faecal and urine samples. Data obtained on nitrogen metabolism and serum biochemical parameters were analyzed using the general linear model (GLM) procedure for repeated measurement analysis of variance (ANOVA) using the software program of statistical analysis system (SAS, 2003). Statistical means were compared using Duncan Multiple Range Test (DMRT).

Results and Discussion

The proximate composition of the experimental diets and guinea grass are shown in Table 1. The dry matter of the experimental diets that ranged from 89.97% for diet 1 to 96.05 for diet III were high, implying the ability to retain more nutrients in the diets. Crude protein of diet I (12.98%), diet II (14.69%) and diet III 915.32% were considerably differed in values with diet III being the highest and diet I the lowest. However the values of crude protein recorded in this study satisfied the Gatemby (2002) recommendation of 10 to 12% crude protein

requirement for growth performance of sheep and goats. Crude fibre that ranged from 26.54% to 38.69% in the diets increased with increasing levels of cowpea husk inclusion in the diets. Ether extract that had the highest value in diet III (3.76%) and lowest in diet I (2.93%) followed similar pattern of variation as observed with crude fibre.

Ash and nitrogen free extract that ranged from 4.03 to 5.09% and 38.20 to 52.46% respectively were varied in values and increased with increasing levels of yam peels inclusion in the diets. Moreover, the guinea grass, crude protein and crude fibre values obtained in this study were similar to the reference values of 7.95% crude protein and 31.00% crude fibre reported by Okoruwa *et al.* (2012).

Table 1: Proximate composition (% DM basis) of the experimental diets and guinea grass.

Parameters	Diets			Guinea grass
	I	II	III	
Dry matter	89.97	94.25	96.05	68.52
Crude protein	12.98	14.69	15.32	7.04
Crude fibre	26.54	32.89	38.69	30.89
Ether extract	2.93	3.38	3.76	3.88
Ash	5.09	4.77	4.03	8.56
Nitrogen free extract	52.46	44.27	38.30	49.63

Table 2: Nitrogen metabolism of dwarf bucks fed vary levels of yam peels and cowpea husk.

Parameters	Diets			SEM±
	I	II	III	
Nitrogen (N) intake (g/day)	6.60 ^c	8.14 ^b	10.00 ^a	0.82
Faecal N-output (g/day)	2.01	2.27	2.29	0.26
Urinary N-output (g/day)	0.82 ^b	1.04 ^a	1.09 ^a	0.09
Total N-output (g/day)	2.83 ^b	3.31 ^a	3.38 ^a	0.93
N-absorbed (g/day)	3.77 ^c	4.83 ^b	6.62 ^a	0.85
N-absorbed (g/day/BW ^{0.75})	2.71 ^c	3.26 ^b	4.13 ^a	0.41
N-retention (%)	57.12 ^c	59.34 ^b	66.20 ^a	1.02
Apparent N-digestibility (%)	69.55 ^c	72.11 ^b	77.11 ^a	0.96

^{a, b, c} means within the same row with different superscripts differ significantly (P<0.05). SEM = Standard error of mean.

Table 3: Serum biochemical parameters of dwarf bucks fed experimental diets.

Parameters	Diets			SEM±
	I	II	III	
Total protein (g/dl)	5.93 ^c	7.08 ^b	8.05 ^a	0.17
Albumin (g/dl)	2.98 ^b	3.16 ^a	3.43 ^a	0.02
Globulin (g/dl)	2.95 ^c	3.92 ^b	4.62 ^a	0.06
Cholesterol (g/dl)	62.99 ^b	73.86 ^a	58.29 ^c	0.21
Creatinine (mg/dl)	0.98	0.92	0.88	0.01
Urea (mg/dl)	30.04 ^a	28.42 ^a	20.07 ^b	1.24
Glucose (mmol/L)	3.69 ^b	3.87 ^b	4.01 ^a	0.05
Calcium (mmol/L)	2.06 ^a	1.99 ^b	1.89 ^b	0.08
Phosphorous (mmol/L)	2.43 ^a	1.92 ^b	1.76 ^b	0.10

^{a, b, c} means within the same row with different superscripts differ significantly (P<0.05). SEM = Standard error of mean.

Nitrogen metabolism of dwarf bucks fed experimental diets are summarized in Table 2. All measured parameters were significantly (P<0.05) affected by the treatments except faecal nitrogen (N) – output that was not significant (P>0.05). Nitrogen (N) – intake for diet III (10.00g/day) was the highest and differed significantly (P<0.05) from diets II (8.14g/day) and I (6.60g/day). The highest N – intake for diet III could probably be due to the high protein content of protein in the diet compared to the protein content in diets II and I. This view is supported by Ahamefulu *et al.* (2001) who earlier reported that high protein content of diet has significant effect on N – intake of dwarf sheep. Though faecal N – output values that ranged from 2.01 to 2.29g/day were not varied significantly (P>0.05) among dietary treatments, diet III recorded the highest while diet I the lowest. Urinary N-output was significantly (P<0.05) higher in diets III (1.09g/day) and II (1.04g/day) compared with

diet I (0.82g/day). The higher values found in diets III and II could be a reflection of ammonia nitrogen concentration in the rumen that depend on the quantity and solubility of the diets fed to the bucks. This is in line with the reports of Ahamefule and Udo (2010) who reported that nitrogen excreted in urine would depend on urea recycling and then efficiency of utilization of ammonia produced in the rumen by microbes for microbial protein synthesis. Total N-output that was higher in diets III (3.38g/day) and II (3.31g/day) in comparison with diet I (2.83g/day) followed similar pattern of variation as observed in urinary N-output. The high faecal and urinary N-output recorded for bucks on N-output recorded for bucks on diets II and III attributed to the higher total N-output obtained for diets II and III. This observation is in consonance with the established facts of Yousuf and Adeloye (2010) who reported that high protein diets promote high N-intake and consequently high faecal and urinary nitrogen. Prvulovic *et al.* (2012) also found that the addition of high protein feed to a diet changes the pattern of nitrogen excretion towards increased nitrogen excretion in faeces and urine.

N-absorbed in g/day and g/day/BW^{0.75} significantly ($P<0.05$) highest in diet III (6.62 and 4.13) followed by diet II (4.83 and 3.26) before diet I (3.77 and 2.71). The gradual increased in trend of N-observed by bucks as the inclusion levels of cowpea husk increased in the diets could be associated with the level of protein content in cowpea husk and the degree of its utilization in the diets. However, the dietary treatments in this study posted positive N-absorbed for all the experimental bucks, suggested that the protein requirement for the bucks were adequately met by the diets. N-retention and N-digestibility which are the function of nitrogen ingested and digested (Ososanya *et al.*, 2013) also differed significantly ($P<0.05$) among dietary treatments. The least N-retention and digestibility were recorded in diet I (57.12 and 6.55%). This increased significantly ($P<0.05$) to diet II (59.34 and 72.11%) and then to diet III (66.20 and 77.11%). N-retention and digestibility tended to improved as N-intake and consequently N-absorbed increased in the dietary treatments. This relative N-absorbed which might have been influenced by N-intake could have probably contributed in no small measured to the higher N-retention and indeed N-digestibility for the more nitrogenous diet III in this study. Notwithstanding, the N-retention and digestibility values obtained in this study were higher than the estimated ranged values of N-retention (28.73 to 46.71%) and N-digestibility (57.26 to 65.23%) for dwarf goats as reported by Okoruwa *et al.* (2013c).

Table 3 shows the effects of dietary treatments on serum biochemical indices of dwarf bucks. Serum parameters have been reported to be important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between the blood and cell could be facilitated (Isidahomen *et al.*, 2012). Ikhimiyoa and Imasuen (2007) also found that serum proteins are important in osmotic regulation, immunity and transport of several substances in the body. Significant differences ($P<0.05$) were noticed in total proteins, albumin and globulin levels in the serum. Bucks offered diet III (8.05, 3.43 and 4.62g/dl) were significantly highest while those fed on diet I (5.93, 2.98 and 2.95g/dl) were the least. One possible explanation for this differences in serum proteins could be the protein availability in the diets for utilization which influenced the proteins level in the serum. However, it is important to note that serum protein values obtained in this study were within the reference mean value of total protein (7.32g/dl), albumin (3.74g/dl) and globulin (3.60g/dl) according to the report of Taiwo and Ogunsanmi (2003) for normal healthy dwarf goats. Measured cholesterol levels in the serum showed significantly ($P<0.05$) highest values for bucks on diet II (73.86mg/dl) followed by diet I (62.99mg/dl) before diet III (58.29mg/dl). The surprising highest effect of cholesterol levels in the serum for diet II could be connected with the enhanced activities of lipase enzymes in the diet that better cholesterol utilization in the digestive tract. This is partially in agreement with the research of Prvulovic *et al.* (2012) who reported that nutritional level and activities of lipase enzymes in the diet improved the activity of cholesterol level in the serum. Treatment diets did not appear to influence ($P>0.05$) the creatinine level in the blood serum of bucks, indicating that treatment diets have no effect on this variable. This explains the effectiveness of body mass function in bucks and fewer waste products in the muscle of the bucks. Serum urea values of 30.04, 28.42 and 20.07mg/dl were obtained for diets I, II and III respectively. Serum urea is assumed to indicate protein breakdown. The higher significant ($P<0.05$) serum urea values observed in diets I and II compared with diet III indicate poor dietary protein utilisation and high level of astringent factors associated with yam peels that are known to diminish nutrient permeability in gut wall as well as increasing the excretion of endogenous protein which is subsequently passed out in the faeces and so may alter protein metabolism (Siyanbola and Amao, 2011). Thus, the utilisation of diet III in the digestive tract by bucks reduced ammonium absorption and its conversion to urea that resulted in decreased urea concentration in the serum. This corroborates the relatively higher N-retention and digestibility observed for bucks on diet III.

Diet III (4.01mmol/L) was significant ($P<0.05$) higher in blood glucose than diets II (3.87mmol/L) and I (3.69mmol/L). The higher blood glucose activity of diet III could be an indication of the characteristics of the diet that appear to supply and maintain a high and relative constant blood glucose levels in the bucks. This corresponds with the findings of Stella *et al.* (2012) on dairy goats in their research concentration of blood glucose that increased by the characteristics of the diet's nutrient. Calcium and phosphorus levels in the serum that ranged from 1.89 to 2.06mmol/L and 1.76 to 2.43 mmol/L respectively were significantly ($P>0.05$) not

differed with diets II and III but lower than diet I. The variable intake levels of calcium and phosphorus in the diets and environmental condition might have interfered with these marked variations in the serum. However, the values of calcium and phosphorous recorded in this study were within the ranged values of 2.20 to 2.43mmol/L and 1.68 to 2.15mmol/L reported for dwarf goats by Ikhimioya and Imasuen (2007).

Conclusion

Based on the results obtained in this study, it was therefore concluded that the combination of yam peels and cowpea husk as feed have the potential of balancing nutritional needs in terms of basal diets component for dwarf bucks, most especially during the dry season. The response in nitrogen metabolism and serum biochemical indices by dwarf bucks indicated that diet III (55.00% yam peels + 20.00% cowpea husk + 25.00% concentrate supplement) was best improved compared to diet I (65.00% yam peels + 10.00% cowpea husk + 25.00% concentrate supplement) and diet II (60.00% yam peels + 15.00% cowpea husk + 25.00% concentrate supplement).

References

- Abara, A.E. (2011). Proximate and mineral element composition of the tissue and peel of *Dioscorea bulbifera* tuber. *Pakistan Journal of Nutrition* 10(6): 543–551.
- Adeokun, O.A., Oladoja, M.A. and Adisa, B.O. (2008). Adoption of improved goat production practices in Ogun State, Nigeria. *Nigerian J. Anim. Prod.* 35(2): 267–274.
- Ahamefule, F.O. and Udo, M.D. (2010). Performance of West African dwarf goats fed raw or processed pigeon pea (*Cajanus cajan*) seed meal based diets. *Nig. J. Anim. Prod.* 37(2): 227–236.
- Ahamefule, F.O., Ibeawuchi, J.A. and Ibemere, J.C. (2001). Digestibility and nitrogen balance studies in West African dwarf sheep fed fortified cassava peel meal-poultry waste diets. *J. Appl. Chem. Agric. Res.* 7: 69–74.
- AOAC (2002). Official methods of analysis, 16th ed. Washington DC: *Association of Official Analytical*.
- Gatemy, R.M. (2002). Sheep. Revised edition. Tropical Agricultural Series. Macmillan Publisher Ltd. Pp. 8–9.
- Ikhimioya, I. and Imasuen, J.A. (2007). Blood profile of West African dwarf goats fed *Panicum maximum* supplemented with *Azelia africana* and *Newbouldia laevis*. *Pak. J. Nutri* 6(1): 79–84.
- Isidahomen, C.E., Njidda, A.A. and Olatunji, E.A. (2012). Heat tolerant traits among local and exotic chickens in southern Nigeria (2012). *IOSR. J. Agric and Vet. Sci.* 1(6): 31–36.
- Okoruwa, M.I., Adewumi, M.K. and Igene, F.U. (2013b). Thermophysiological responses of West African dwarf (WAD) bucks fed *Pennisetum purpureum* and unripe plantain peels. *Nig. J. Anim. Sci.* 15: 168–178.
- Okoruwa, M.I., Adewumi, M.K. and Njidda, A.A. (2013a). Nutrient utilization and growth performance of West African dwarf goats fed with elephant grass or different proportion of plantain and mango peels. *World Journal of Agricultural Sciences* 1(6): 194–202.
- Okoruwa, M.I., Igene, F.U. and Isika, M.A. (2012). Replacement value of cassava peels with rice husk for guinea grass in the diet of West African dwarf sheep. *Canadian J. Agric. Sci.* 4(7): 254–261.
- Okoruwa, M.I., Obiku, A. and Agbonlahor, I. (2013c). Performance evaluation of West African dwarf goats fed unripe plantain peels as replacement for *Pennisetum purpureum*. *Nig. J. Anim. Sci.* 15:113–124.
- Ososanya, T.O., Alabi, B.O. and Sorunke, A.O. (2013). Performance and digestibility of corncob and cowpea husk diets by West African dwarf sheep. *Pak. J. Nutri.* 12(1): 85–88.
- Prvulovic, D., Kosarcic, S., Popovic, M., Dimitrijevic, D. and Gruber-Lajsic, G. (2012). The influence of hydrated aluminosilicate on biochemical and haematological blood parameters, growth performance and carcass traits of pigs. *J. Anim. and Vet. Adv.* 11(1): 134–140.
- SAS (2003). *Statistical analysis system user's guide: Statistics version*. Cary, Nc: SAS Institute.
- Siyabola, M.F. and Amao, E.A. (2011). Effect of replacement of yam (*Dioscorea* spp) peel meal for maize (*Zea mays*) on growth performance, carcass characteristics and blood chemistry of finisher broilers. *J. Agric and Bio Sci.* 2(1): 018–021.
- Stella, A.V., Paratte, R., Valnegari, L., Cigaline, G., Soncini, G. (2007). Effect of administration of live *Saccharomyces cerevisiae* on milk production, milk composition, blood metabolites and faecal flora in early lactating dairy goats. *Small Rum Res.* 67: 7–13.
- Stella, A.V., Parette, R., Valnegri, L., Cigalino, G., Soncini, G., Chevaux, E., Dell'Orto, V., Savoini, G. (2007). Effect of administration of live *Saccharomyces cerevisiae* on milk production, milk composition, blood metabolites and faecal flora in early lactating dairy goats. *Small Ruminant Research.* 67: 7–13.
- Taiwo, V.O. and Ogunsdanmi, A.O. (2003). Haematology, plasma, whole blood and erythrocyte biochemical values of clinically healthy captive reared grey duicker (*Sylvicapra grimmia*) and West African dwarf sheep and goats in Ibadan, Nigeria. *Isr. J. Vet. Med.* 58(1): 21–26.
- Tsado, D.N., Aremu, A., Egena, S.S.A. and Ismah, O. (2009). Assessment of body weight of savanna brown

- goat, castrates, non-castrates and females using linear measurement. *34th Annual Conf. of Nig. Soc. for Anim. Prod.* Pp. 500–503.
- Waziri, M.A., Ribadu, A.Y. and Sivachelvan, N. (2010). Changes in the serum proteins, haematological and some serum biochemical profiles in the gestation period in the Sahel goats. *Vet. Arhiv* 80(2): 215–224.
- Yousuf, M.B. and Adeloje, A.A. (2010). Performance responses of goats fed shed leaves (*Vitellaria paradoxa*, *Gmelina arborea* and *Daniella oliveri*) based diets. *Nig. J. Anim. Prod.* 37(2): 99–105.

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