

Performance and carcass characteristics of weaner pigs fed dietary raw bambarra nut offal

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Abstract

A 56-day feeding trial using twelve (12) crossbred weaner pigs of 8 weeks of age and average weight of 10.58±0.17kg were used to investigate the effect of different dietary levels of raw bambara groundnut offal on their growth and carcass characteristics. Four diets were formulated to contain raw bambara groundnut offal at 0, 10, 20 and 30%, designated T_1, T_2, T_3 and T_4 respectively. The weaner pigs were randomly assigned to the four (4) diets in a completely randomized design (CRD) experiment. Chemical composition of the test ingredient and diets were analysed. Data collected include feed intake, weight gain, feed conversion ratio (FCR), protein efficiency ratio (PER) and economics of production. The carcass characteristics were also evaluated. The proximate composition of the experimental diets revealed that the crude protein and ether extract contents of the diets decreased with increased levels of raw BGO in the diets, but the converse was true for crude fibre and ash contents. The results indicated significant differences ($p< 0.05$) in daily weight gain (DWG), feed conversion ratio, protein efficiency ratio, cost (N) /kg of feed and cost (N)/kg weight gain. The values were, 0.34, 0.29, 0.28 and 0.22kg for DWG, 3.03, 3.62, 3.55, and 4.30 for FCR in T_1, T_2, T_3 and T_4 respectively. Protein efficiency ratio, values were 1.84, 1.54, 1.57 and 1.29. Cost /kg of feed values were 75.69, 70.13, 64.56 and 56.10, and cost (N)/kg weight gain were 229.32, 253.86, 229.20 and 253.69 for the treatments respectively. The results of the carcass evaluation indicated significant differences ($p< 0.05$) for ham and trotters. The values were 0.31, 0.35, 0.37 and 0.32 for ham in T_1, T_2, T_3 and T_4 respectively. The values of trotters were, 64.6, 56.99, 56.98 and 53.66 among the treatments. For organs characteristics, the results indicated significant differences ($p< 0.05$) for lung, kidney, liver and spleen. The values of the lungs were, 11.20, 11.25, 9.40 and 8.97 among the treatments. The values of kidney and liver were, 3.34, 2.86, 3.72 and 3.14, and 24.28, 28.57, 22.55 and 27.70 respectively. The inclusion of up to 20% raw BGO in the diet of weaner pigs recorded comparable daily weight gain, feed conversion ratio and cost/kg weight gain with the group fed the control (0% raw BGO). Further studies involving heat treatment of the BGO might be necessary to improved nutrient utilization by the animals, and also increase inclusion level.

Keywords: Weaner pigs, bambara nut, offal, diet, growth, carcass

Introduction

Nigerian pig industry is facing setback and on the verge of collapse due to high cost of pig feed which accounts for 70-80% of the total cost of pig production (Olomu, 1995). The escalating market prices of cereal grains especially maize which forms the bulk of pig diet is highly competitive and not readily available because of the high demand by human as staple food and it's industrial use.

Swine production among other species has a high potential to contribute to high economic gain, this is because pigs have

high fecundity, high feed conversion ratio, early maturing, short generation interval and relatively small space requirement (Lekule and Kyysgaard,2003) providing 44% of meat in the world market (FAO,2001).

A large number of alternative feedstuffs which have potentials as monogastric feed ingredients abound in Nigeria (Ologhobo,1992).These include industrial by-products and agricultural wastes like maize offal, soyabean hull, cowpea hull etc, whose composition and potential nutritive values are just becoming known (Longe,1987). However, there are no reliable production statistics for those by-products because of scattered processing centers (Fetuga and Tewe, 1994). Moreover poor industrial and technological base of the country results in fragmental supply of these materials and this make standardization for physical quality or nutrient content difficult. Feed producers using these categories of ingredients can hardly maintain standards.

Bambara groundnut (*Vigna subterranea*) has been reported to be good source of plant protein that is useful for feeding of chicks (Oluyemi *et al.,* 1976; Olomu*,* 1995). Its use has been reported by many workers (Chizoba, 1983; Linnemann, 1990). It is difficult to obtain accurate yield figure for bambara groundnut in Nigeria.

Detailed study of the nut showed that it contains some anti-nutritional factors such as trypsin inhibitor and polyphenol (Poulter, 1981).The cream coloured types have relatively high content of essential amino acid, fairly low phytic acid, low saponin and negligible tannin contents (Temple and Aliyu, 1994). However, all processing methods reduce the phytic acid content by up to 56%. Sprouting increases it's protein content while roasting tends to reduce the level of all constituent except carbohydrate (Igbodioh *et al*., 1994).

Bambara groundnut is the only legume which its seeds are referred to and used as complete food because they contain protein, carbohydrate and fat in sufficient proportions to provide a nutritious food (Poulter and Caygill, 1980; Goli, 1995).

The proximate composition of seed has been reported by Olomu (1995) as 20.6% CP; 6.3% EE; 4.0% CF; 4.2% Ash and 54.9% NFE, although these vary with different processing methods as have been reported by Igbodioh *et al*. (1994). Okah *et al*. (2006) reported the proximate composition of raw and autoclaved bambara nut as; 17.71% CP, 3.05% CF, 13.30% EE, 3.15% Ash and 49.29% NFE for raw bambara nut, and 16.83%CP,4.10%CF,12.40% EE,3.25%Ash and 50.67%NFE for autoclaved bambara nut.

The offal contains about 17.90-21.16% CP (Ezuoke, 2003; Amaefule and Iroanya, 2004; Amaefule and Osuagwu, 2005), 5.29% CF and 12.44 MJ/Kg gross energy (Ezuoke, 2003; Amaefule and Iroanya, 2004). Leucine has been stated to be most concentrated essential amino acid found in bambara groundnut (Olomu, 1995; Aremu *et al*., 2006). The objective of this study was to determine the growth performance and carcass characteristics of weaner pigs fed dietary levels of bambarra nut offal.

Materials and methods

Experimental site

The experiment was conducted at the piggery unit of the Teaching and Research farm of the College of Animal Science and Animal Production (CASAP), Michael Okpara University of Agriculture Umudike, Umuahia, Abia State, located at latitude 5° 29' north and longitude 1.7° 32' east in the rain forest zone of Nigeria. The experiment was conducted within July and

August 2013.The climate of the region is characterized by a mean daily temperature of between 27°C and 35°C all through the year. Average rainfall of the place is about 2000mm per annum with double maxima pattern (NRCRI, 2014).

Experimental diets

Four (4) diets were formulated to contain raw bambara nut offal at 0, 10, 20 and 30% levels of inclusion (table 1).

Table 1: Composition of experimental diets containing different levels of raw bambara nut offal

Ingredients (%)	T_1	T_2	T_3	T_4
Maize	39.80	32.80	25.80	18.80
SBM	18.00	15.00	12.00	9.00
BGO	0.00	10.00	20.00	30.00
Maize offal	12.00	12.00	12.00	12.00
PKC	27.00	27.00	27.00	27.00
Bone meal	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Vit/Min Premix*	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
CP(%)	18.22	17.58	16.94	16.30
ME(Kcalkg^{-1})	2872.37	2569.08	2375.76.	2162.45

SBM= Soybean meal; BGO= Bambara nut offal

*supplied per kg diet: Vit. A 7500IU; Vit. D 750; Vit. K 3mg; Thiami ne 10mg; Riboflavin 5mg; Niacin 20mg; Pantothenate 15mg; Vit. B 22mg; Biotin 50mg; Choline 300mg; Magnessium 500mg; lodine 0.20mg; Zinc 100mg; Iron 90mg; Manganese 20mg; Selenium 0.15mg; methionine 0.10% and Lysine 0.10%.

Experimental Animal and Procedure

Twelve (12) crossbred weaner pigs (Large white x Landrace), 8 weeks of age and weighing between 10.33 and 10.67kg were purchased from the University commercial farm for the study. The animals were first quarantined for 21days within which they were dewormed and also treated for mange. They were then divided into four groups of three (3) animals each and randomly assigned to the four treatment diets in a completely randomized design (CRD). The animals were housed in individual pens, weighed at the beginning of the experiment and weekly thereafter. Feed and clean water were offered *ad-libitum.* The quantity of feed left –over was subtracted from the quantity offered to arrived at feed intake. The study lasted 56 days, at the end of which the derived parameters, feed conversion ratio, feed efficiency ratio and protein intake were calculated.

Chemical Analysis

Proximate analysis of the test ingredient and the experimental diets were carried out using the procedure of the AOAC (2012) (table 2).

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) according Steel and Torrie (1980), where significant differences existed between the means, Duncan multiple range test was use to separate the means (Duncan, 1955) using SAS (2001).

Results and Discussion

The proximate composition of raw bambara groundnut offal (BGO) is presented in table

2. The results indicated a crude protein content of 12.43% which is lower than 17.90% reported by Amaefule and Osuagwu (2005). The ether extract of 3.27% reported in this study is lower than the 6.30% (Olomu, 1995). The crude fiber of 13.00% obtained for raw BGO in this study is also higher than the 11.30% obtained by Amaefule and Osuagwu (2005) and 5.40% reported by Amaefule and Iroanya (2004). The ash content (3.11%) of BGO reported herein is similar to the 3.15% (Okah et al., 2006). However, the 57.38% NFE is close to the 54.90% reported by Olomu (1995). The bambara groundnut offal is obtained by manual sieving of milled bambara groundnut while separating the flour for human consumption. The extent of sieving, amount of residual flour, particle size and the sieving skill of the miller affect the quality or the proximate composition of bambara groundnut offal. These factors could lead to variations among bambara groundnut offal obtained from different millers, and over a period of time. The low crude protein content of the BGO used in this study was as a result of repeated milling and sieving of the bambara nut seed. The crude protein content of the control diet was higher ($p<0.05$) than the values obtained from the raw BGO diets. The crude protein content of the BGO diets decreased with increase in the level raw BGO and decrease in the level of soybean meal in diets due to lower CP content of BGO relative to soybean meal. Higher ($p<0.05$) ether extract value in the control diet (T_1) might be due to higher oil content of SBM compared to raw BGO. The crude fibre content of diets increased with level of BGO in the diet due high fibre content the BGO used in the experiment. The NFE (%) and GE ($Kcalg^{-1}$) differed significantly ($p<0.05$) without a definite pattern, and appeared to have been due to varying ratios of the variable ingredients (maize, SBM and BGO).

Table 2: Analyzed composition of the experimental diets containing different levels of raw bambara nut offal and BGO

Constituents	T_1	T_2	T_3	T_4	SEM	BGO
Dry Matter (%)	89.66^{a}	89.43^{b}	89.38^{b}	89.73^{a}	0.09	89.19
Crude Protein (%)	13.83^{a}	12.95^{b}	11.90^{c}	9.98^{d}	0.21	12.43
Ether Extract (%)	4.60^{a}	4.56^{a}	4.32^{b}	2.84^{c}	0.04	3.27
Crude Fibre (%)	3.94^{d}	6.20^{c}	6.53^{b}	7.25^{a}	0.04	13.00
Ash (%)	3.41^{d}	4.09^{c}	7.41^{b}	8.71^{a}	0.01	3.11
NFE (%)	63.88^{a}	61.63^{b}	59.22^{d}	60.95^{c}	0.27	57.38
GE($Kcalg^{-1}$)	334.40^{a}	333.76^{a}	324.76^{c}	331.12^{b}	0.58	308.67

$^{a, b, c, d}$ Means within the same row with diff erent superscript differ significantly ($P<0.0\,5$). NFE – Nitrogen Free Extract

Performance of wearner pigs fed graded levels of raw bambara nut offal is presented in table 3. The daily weight gain (kg), significantly ($p<0.05$) declined from the control (T_1 = 0% BGO) 0.34 to 0.22 in the T_4 (30%BGO) group. Daily feed intake also decreased significantly ($p<0.05$) from T_1 to T_4. The reduction in fed intake might be due to the presence of some anti nutritional factors like trypsin inhibitors, polyphenol (Temple and Aliyu, 1994). Reduction in palatability with increase in the level of raw BGO in diet may have resulted in decrease in feed intake. Earlier studies elsewhere (Ani *et al.*, 2010) had indicated that palatability influences feed intake and the

Table 3: Performance weaner pigs fed graded levels of raw bambara nut offal

Parameters	T_1	T_2	T_3	T_4	SEM
Initial weight(kg)	10.67	10.67	10.33	10.66	1.80
Final weight (kg)	29.67^{a}	27.00^{ab}	26.00^{ab}	23.00^{b}	1.93
Total weight gain (kg)	19.00^{a}	16.33^{ab}	15.67^{ab}	12.33^{b}	1.41
Daily weight gain (kg)	0.34^{a}	0.29^{ab}	0.28^{ab}	0.22^{b}	0.03
Daily feed intake (kg)	1.03^{b}	1.06^{a}	0.99^{c}	0.95^{d}	0.01
Feed conversion ratio	3.03^{c}	3.62^{b}	3.55^{bc}	4.30^{a}	0.19
Protein intake(kg)	10.35	10.63	10.01	9.53	1.21
Protein efficiency ratio	1.84^{a}	1.54^{b}	1.57^{b}	1.29^{c}	0.01
Cost(₦) /kg of feed	75.69^{a}	70.13^{b}	64.56^{c}	59.10^{d}	0.25
Feed cost(₦)/Kg pig	146.69^{b}	153.45^{a}	137.96^{c}	135.85^{c}	2.02
Cost(₦)/Kg weight gain	229.32^{b}	253.86^{a}	229.20^{b}	253.69^{a}	7.08

^{a,b,c,d} Means on the same row with different superscript differ significantly ($p<0.05$)

Table 4: Carcass characteristics of weaner pigs fed raw bambara nut offal

Parameters	T_1	T_2	T_3	T_4	SEM
Fasted weight (Kg)	30.00^{a}	28.00^{ab}	26.67^{ab}	24.00^{b}	1.23
Dressed weight(Kg)	18.00^{a}	16.67$^{a\,b}$	15.00^{bc}	13.00^{c}	0.93
Dressing percentage (%)	60.00	59.54	56.24	54.17	11.32
Head (%)	0.18	0.20	0.21	0.18	0.10
Ham (%)	0.31	0.35	0.37	0.32	0.19
Shoulder (%)	0.42	0.41	0.42	0.39	0.24
Lion (%)	0.24	0.24	0.22	0.25	0.20
Bone-to-lean ratio	0.21	0.21	0.20	0.22	0.06
Trotter (%)	64.61^{a}	56.99$^{a\,b}$	56.98$^{a\,b}$	53.66^{b}	2.08
Belly (%)	14.01	16.61	18.31	15.99	2.18
Tail (%)	2.80	3.88	3.42	3.72	1.98

^{a,b,c} Means within the same row with different superscript differ significantly ($p<0.05$)

Table 5: Organs characteristics of weaner pigs fed raw bambara nut offal

Parameters (%)	T_1	T_2	T_3	T_4	SEM
Lungs	11.20^{a}	11.25^{a}	9.40$^{a\,b}$	8.97^{b}	0.68
Heart	4.62	5.46	4.21	4.74	1.33
Kidney	3.34$^{a\,b}$	2.86^{b}	3.72^{a}	3.14$^{a\,b}$	0.14
Liver	24.28^{c}	28.57^{a}	22.55^{d}	27.70^{b}	0.31
Spleen	1.50	1.43	1.39	1.15	0.33

^{a,b,c,d} Means within the same row with different superscript differ significantly ($P<0.05$)

overall performance of the animals. The high fibre content of the raw BGO obtained in this study might also be responsible for reduction in feed intake by the animals. Depressed feed intake and poor performance of pigs due to high fibre in diets had earlier been reported (Onyimonyi and Okeke, 2008; Akinmutimi and Ogu, 2009). The significantly ($p<0.05$) poor feed conversion ratio of 4.30 of animals fed 30% raw BGO when compared to the 3.03 of the control (T_1) group is due to low intake observed in the group, which is attributable to the presence of anti-nutritional factors

and high dietary fibre or their interaction. Protein intake by animals in the various groups did not differ ($p>0.05$) significantly. However, the differences in utilization of protein as shown by the protein efficiency ratio appears to indicate that the dietary protein was not equally utilized by all the groups, owing probably to the presence of anti-nutritional factors in the raw BGO diets. Poor nutrient utilization as a result of anti-nutritional factors in feed had been reported in grower pigs by Akinmutimi and Ogu (2009). The inclusion of agro/industrial by-products or waste that are free from human or industrial competition generally reduce livestock feed cost and by extension, production cost (Okah et al., 2013). However, the real index of the usefulness of any feedstuff in reducing cost of production is the quantum of influence on the animals' performance. Table 4 represents the carcass characteristics of weaner pigs fed graded dietary levels of raw BGO.

Fasted weight (kg) was higher ($p<0.05$) for animals on the control (T_1) diet than for those fed (T_4) 30% raw BGO (table 4). The dressed weight was also higher ($p<0.05$) for the control group than for those on the 20 % (T_3) and 30 % (T_4) raw BGO. Dressing percentage, ham, shoulder and loin did not indicate significant differences ($p>0.05$) among the treatment means. The relative weights of trotters followed the same pattern with the fasted weight, indicating that the weight of trotters is directly related to the weight of the pig. The similar ($p>0.05$) values recorded in the dressing percentage and major cut parts, viz. ham, shoulder and loin seem to suggest that all the diets supported carcass yield relative to the amount of feed consumed. This view had earlier been reported by Olayeni et al. (2009) when they fed wildsunflower/blood meal mixture to weaner pigs. The higher ($p<0.05$) fasted weight of the control group than the 30% raw BGO group followed the same pattern with the final weight and weight gain. The relative organ weights (table 5).indicated significant differences ($p<0.05$) in the lungs kidney and liver, while the heart and spleen were similar ($p>0.05$). Decrease in relative weight of the lungs had also been reported by Olayeni et al. (2009). The differences observed in the values of the kidney and liver did not follow the pattern of dietary levels of raw BGO as to pin it to the effect of the test ingredient. However, the higher relative weight of liver in the 10% (T_2) and 30% raw BGO groups than in the 0% (T_1) and 20% (T_4) raw BGO might be associated with traces of anti-nutritional factors intake relative the body weight of the animals.

Conclusion and recommendation

The results of the study indicated that 20% raw BGO in the diet of weaner pigs compared favourably with the control group (0% raw BGO), and did not show any adverse effect on the animals. The measured parameters like daily weight gain, FCR and cost (N)/kg weight gain were similar in the control (0% raw BGO) and 20% raw BGO. The study reveals that up to 20% raw BGO can be included in the diet of weaner pigs without adverse effect on performance and economics of production. However, employing heat treatment on the offal might likely reduce anti nutrients for increased level of inclusion and also improve utilization nutrients.

References

Akinmutimi, A. H. and Ogu, E. K. 2009. Nutritional evaluation of toasted Mucuna Sloanei meal in the diet of grower pigs. *Proc. 14th Ann. Conf. Anim. Soc. Ass. Nig. (ASAN).* Sept. 14th-17th 2009, Ogbomoso,

Nig. Pp. 425-428.

Amaefule, K. U. and Iroanya, C. O. 2004. Replacement of soya bean meal and maize offal with bambara groundnut offal in broiler diets. Nig. Agric. J., 35: 133-142.

Amaefule, K. U. and Osuagwu, F. M. 2005. Performance of pullet chicks fed raw bambara groundnut (Vigna subterranean (L) Verdc) offal diets as replacement for soybean meal and maize. *Livestock Research for Rural Development* (LRRD) Vol. 17, Art.5

Ani, A. O., Ikeh, I. E. and Kalu, I. 2010. Growth performance of weaner pigs fed soybean hull based diets. Proc. 35th Ann. Conf. of Nig. Soc. for Anim. Prod. 14th - 17th March, 2010, Univ. of Ibadan Nig. Pg.461-464.

A.O.A.C. 2012. Official method of Analysis, Association of Official Analytical Chemist, and 19th edition Washington D.C. pp. 88-109.

Aremu, M. O., Olaofe, O. and Akintayo, E. T. 2006. A comparative study on the chemical and amino acid composition of some Nigerian under-utilized legume flours. *Pakistan Journal of Nutrition,* 5 (1): 34 - 38.

Chizoba, C. I. 1983. Nutritive value of Cowpea,Bambara groundnut-Rice mixture in Adult rat Nutrition. *Rep.Int*. 27. 209-212.

Duncan, D. B.1955. New multiple range and multiple F-tests. Biometrics, 14: 1-45

Ezuoke, O. C. 2003. Biochemical Heamatological and Nutritional Evaluation of raw and taste bambara groundnut By-product using Rabbits Thesis. College of Animal Science and Animal Health; Michael Okpara University of Agriculture, Umudike, pp: 15-16.

FAO. 2001. Bulletin of Statistics. Vol.2, No.1. Food and Agriculture Organization of the United Nations.

Fetuga, B. L. and Tewe, O. O. 1994. Comparative nutritional Evaluation of full-fat soyabean and some animal protein concentrates. *Trop. Oilseed Journal* 2 (1): 45-50.

Goli, A. E. 1995. Bibliographical Review in Proceedings of the Workshop on Conservation and Improvement of Bambara Groundnut *(Vigia subterranean (L.)verdc)* Harare, Zambabwe.

Igbodioh, S. O., Olugbemi, K. T. and Akpapunam, M. A. 1994. Effect of processing methods on phytic acid level and constituents in Bambara groundnut and pigeon pea. Food-chem. 50, 147-151.

Lekule, P. F. and Kyvsgaard, N. C. 2003. Improving pig husbandry in tropical resource poor communities and its potential to reduce risk of porcine cysticercosis. *Acta Tropical,* 87: 111-117.

Linnemann, A. R. 1990. Cultivation of bambara groundnut in Western province,Zambia. Report of field study. Trop. Crop commum., 16 Wagoningen Agric. University.

Longe, O. G. 1987. Microbial protein in diet for rat. Nig. J. Anim. Prod. 4(1): 109-122.

NRCRI 2014. Agro-Meteorology Unit. National Root Crop Research Institute, Umudike, Nigeria.

Okah, U., Akinmutimi, A. H. and Onwudike, O. C. 2006.

Determination of metabolizable energy values of bambara groundnut (Voanzeia subterranea) meals. Proc. 11th Ann. Conf. Anim Sci of Nig. (ASAN) Sept. 18-21, 2006. I. A. R. and T. Ibadan, Nigeria.

Okah, U. Akpan, A. A. and Okeke, U. L. 2013. Dietary poultry droppings and maggot Combination for West African Dwaf (WAD) goat. *Int. J. of Appl. Res. and Tech.* 2(4): 92-99.

Olayeni, T. B., Farinu, G. O. and Ojediran, T. K. 2009. Performance andCarcass characteristics of weaner pigs fed wildsunflower-Blood meal mixture diets. Proc. 14th Ann. Conf. Anim. Soc. Ass. Nig. (ASAN). Sept. 14th-17th 2009, Ogbomoso, Nig. Pp.393-396.

Ologhobo, A. D. 1992. The nutritive value of some tropical west African legumes for poultry. J. Applied Anim. Research 2 (2): 93-104.

Olomu, J. M. 1995. Non-Ruminant Animal Nutrition. Nachem Nigeria. P. 108

Oluyemi, J. A., Fetuga, B. L. and Endeley, A. N. L. 1976. The metabolisable energy value of some feed ingredients for young chicks. *Poult. Sci. 55*: 6611-618.

Onyimonyi, A. E. and Okeke, G. C. 2008. Nutritional evaluation of cassava (*Manihot esculenta* Cranz.) peel in the diet of weaner pigs. *Nig. J. Anim. Prod*. 5; 82-87.

Poulter, N. H. 1981. Properties of some protein fraction from bambara groundnut. *J. Sci. Food Agric.* 32: 44-50.

Poulter, N. H. and Caygill, J. C. 1980. Vegetable milk processing and rehydration characteristics of Bambara groundnut (Voanzia subterranean (L) Thou.) *J. Sci. Food Agric*. 31(11): 1158-1163.

SAS, 2001. Users Guide. Statistical Analysis System Procedure, SAS Institute, Inc.Carry Nort Carolina, USA.

Steel, R. G. D. and Torrie, J. H. 1980. *Principles and Procedures of Statistics.* (2nd edition). McGraw-Hill Inc., Tokyo, Japan 633pp.

Temple, V. J. and Aliyu, R. 1994. Proximate composition of the cream colored decorticated seeds Bambara groundnut. Bio Sci. Res. Commur. 6: 51-54.

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