INTAKE AND NUTRIENT UTILIZATION BY EARLY WEANED WEST AFRICAN DWARF KIDS FED SOYABEAN DIET AS REPLACER FOR MILK

OKAGBARE G. O.¹ AND AKINSOYINU A.O.²

¹*Department of Animal Science, Delta State University, Asaba Campus, Asaba*

²*Department of Animal Science, University of Ibadan, Ibadan*

Received 05 May 1997; Accepted 20 July 1998

ABSTRACT

Twenty-one early weaned West African dwarf (WAD) goats weighing 1 - 1.5kg at birth were used to assess the utilization of nutrients by kids fed soyabean diet (SD) as replacer for milk. Replacement of milk with SD up to 50 percent had no significant ($P > 0.05$) effect on dry matter intake of kids. Nutrient digestibility values however decreased ($P < 0.05$) with replacement of milk with SD up to 50 percent level. The digestibility of nutrients increased ($P < 0.05$) with age of the kids. Weight gain of the kids (up to 9 weeks of age) reduced with partial replacement of milk with SD up to 50 percent level. Values recorded for average daily weight gain (g/day) for the kids for diets containing 0, 25, and 50 percent SD were 11.2, 6.7 and 3.0, respectively at 4 weeks of age and 24.3, 19.2 and 7.8, respectively at 6 weeks of age. 25 percent replacement of milk with SD gave adequate performance of pre-weaned kids. The result also showed that the level of replacement of milk with SD could be increased up to 50 percent only after 6 weeks of age.

Key Words: Pre-weaned goats, soyabean diet, milk replacer.

INTRODUCTION

In Nigeria, the mortality of pre-weaned goats is high. Upton (1985) reported a mean mortality rate of 33 percent. Opasina (1985) indicated malnutrition and starvation as major factors responsible for mortality of pre-weaned kids. This can be attributed to the low milk yield of does with the resultant inability to cope with the demands of the kids (Okagbare and Akinsoyinu, 1996). In an effort to address this problem, a study was conducted by Okagbare and Akinsoyinu (1996) in which

soyabean diet (SD) was fed as replacer for milk. Their results indicated that replacement of milk with 25 percent SD will give adequate performance of pre-weaned kids. They further indicated that this level can be higher from 6 weeks after birth, but not exceed 50 percent of replacement with SD. However, there was no information on nutrient utilization by the kids fed SD. This study is therefore, aimed at assessing the utilization of nutrients by pre-weaned West African dwarf (WAD) goats fed SD replacer for milk.

MATERIALS AND METHODS

The experimental diets:

Three isonitrogenous diets were prepared using dried whole milk, soyabean concentrate, and corn starch as the main sources of protein. The preparation of corn starch, soyabean concentrate and dried whole milk has been reported elsewhere (Okagbare and Akinsoyinu, 1996). Dried corn starch and soyabean concentrate were analysed separately for their protein content and formulated into a 24 percent crude protein diet and was used to replace the milk protein at 0, 25 and 50 percent levels. Each diet was then reconstituted with water to obtain a 14.5 percent total solid solution.

Experimental procedure:

Twenty-one early weaned kids, weighing 1-1.5kg at birth were obtained from does reared at the University of Ibadan Teaching & Research Farm and divided at random into three equal groups. Each group of seven goat kids was placed on one of the experimental diets (Table 1) for a period of twelve weeks. The kids were allowed to receive colostrum from their dams for the first 6 days and on the 7th day, they were separated from the does and housed indoor in individual metabolic

TABLE 1: GROSS COMPOSITION OF EXPERIMENTAL DIETS (PERCENT)

Constituents	Diets			
	1	2	3	4
Soyabean concentrate	-	11.25	22.5	33.75
Corn starch	-	13.75	27.45	41.2
Dried whole milk	99.95	75.0	50.0	25.0
*Vitamin/Mineral premix	0.05	0.05	0.05	0.05

*Vitalyte (Analysis per 100g) - Vitamin A (I.U) 15,000,000, vitamin D₃ (I.U) 4,400,000; vitamin E (I.U) 1,350; vitamin K (mg) 4,350; vitamin B₂ (mg) 11,350, vitamin C (mg) 1,000. Nicotinic acid (mg) 16,700, pantothenic acid (mg) 5,350, KCl, 87g; NaSO₄, 212g; NaCl 50g; MgSO₄, 12g; CuSO₄, 12g; ZnSO₄, 12g; MnSO₄, 12g; Lysine 15g; Methionine 10g; Lactose 1,000g.

TABLE 2: CHEMICAL COMPOSITION OF EXPERIMENTAL DIETS*

Nutrients	Diets		
	1	2	3
Dry matter (%)	96.90	95.66	95.4
Crude protein (%)	24.0	23.66	23.56
Nitrogen-free extract (%)	-	46.56	50.65
Lactose (%)	42.96	-	-
Crude fibre (%)	-	1.02	1.48
Milk fat (%)	28.0	-	-
Ether extract	-	23.81	19.71
Total ash (%)	5.04	4.95	4.60
Gross energy (Kcal/g)	5.92	5.43	4.92
Iron (ppm)	50.0	79.0	97.0
Copper (ppm)	20.0	92.0	160.0

*On dry matter basis

cages.

The kids were bottle-fed daily from graduated glass feeding bottles at 0800, 1300 and 1800 hours. The diets were warmed to 35°C and fed to appetite.

Kids were dipped monthly after attaining 6 weeks of age in a solution of 1:500 gamalin 20 against ectoparasites. The kids were weighed regularly, first at birth, on the 7th day of life before being assigned to the experimental diets, and thereafter at weekly intervals before the morning feeding.

Metabolic studies were conducted when the kids were 4, 6, 9 and 13 weeks old. During the study, faecal output from each animal was weighed and their dry matter was determined daily. The dried faeces collected was bulked and stored in cellophane bag at room

temperature for two weeks before analysis. Urine output volume was also measured daily in plastic containers containing 10 mls of 10 percent H₂SO₄. 10 percent of the output was bulked and stored in a deep freezer for one week before analysis.

Samples of feed and faeces were analysed for their dry matter, crude protein, ether extract, crude fibre, nitrogen-free extract and ash contents and urine samples were analysed for their nitrogen content by methods of A.O.A.C (1984). Lactose in milk was determined by the method of Marier and Boulet (1959). The determination of energy values of feeds, faeces and urine samples were done using the Ballistic bomb calorimeter (Gallenkamp U.K). The analysis of variance was carried out on parameters measured and

SOYABEAN DIET FOR EARLY WEANED GOATS

TABLE 3: DRY MATTER INTAKE, LIVEWEIGHT AND NUTRIENT DIGESTIBILITY COEFFICIENT BY PRE-WEANED (WAD) KIDS FED SOYABEAN DIET AS REPLACER FOR MILK

Age in Weeks:	4			SEM	6			SEM	9			SEM	13			SEM
Diets:	1	2	3		1	2	3		1	2	3		1	2	3	
(i) Animal responses:																
Dry Matter intake (g/day)	42.6 ^a	44.8 ^a	42.6 ^a	1.0	54.7 ^a	51.1 ^a	51.8 ^a	1.1	65.4 ^a	66.4 ^a	65.4 ^a	0.8	74.7 ^a	75.1 ^a	75.1 ^a	0.7
Dry Matter intake (as percentage of liveweight)	2.6 ^a	2.7 ^a	2.8 ^a	0.2	2.8 ^a	2.7 ^a	3.2 ^b	0.2	2.7 ^a	2.8 ^a	3.2 ^b	0.1	2.3 ^a	2.5 ^a	2.7 ^a	0.1
Live weight gain (g/day)	11.2 ^a	6.7 ^b	3.0 ^c	0.1	24.3 ^a	19.2 ^b	7.8 ^c	0.1	25.4 ^a	24.8 ^a	22.0 ^b	0.2	26.7 ^a	25.4 ^a	28.0 ^a	0.2
(ii) Digestibility coefficients(g):																
Dry Matter	81.3 ^a	72.6 ^b	44.0 ^c	0.5	83.4 ^a	78.9 ^a	52.1 ^b	0.4	85.9 ^a	81.9 ^a	61.3 ^b	0.5	92.1 ^a	87.1 ^a	73.0 ^b	0.4
Crude protein	83.4 ^a	70.4 ^b	49.6 ^c	0.3	94.8 ^a	80.0 ^b	56.3 ^c	0.4	96.3 ^a	88.7 ^b	68.9 ^c	0.4	97.3 ^a	89.0 ^b	74.0 ^c	0.4
Ether extract	80.7 ^a	65.1 ^b	40.9 ^c	0.4	84.4 ^a	68.7 ^b	47.9 ^c	0.3	83.9 ^a	69.4 ^b	55.9 ^c	0.5	88.4 ^a	70.3 ^b	63.7 ^c	0.4
Crude fibre	-	24.7 ^a	24.9 ^a	0.6	-	28.3 ^a	35.9 ^b	0.6	-	52.8 ^a	54.9 ^a	0.3	-	52.6 ^a	57.0 ^a	0.2
Nitrogen-free extract	80.3 ^a	71.3 ^b	46.0 ^c	0.5	86.3 ^a	74.3 ^b	61.3 ^c	0.4	88.4 ^a	81.0 ^b	66.9 ^c	0.5	93.0 ^a	83.9 ^b	77.3 ^c	0.5
Energy	82.2 ^a	69.6 ^b	48.1 ^c	0.5	87.9 ^a	75.2 ^b	62.6 ^c	0.4	95.3 ^a	86.4 ^b	77.6 ^c	0.3	95.9 ^a	91.6 ^{ab}	88.3 ^b	0.4

Means along the same row within the same age bracket with different superscripts are significantly different ($P < 0.05$).

TABLE 4: UTILIZATION OF NITROGEN AND ENERGY BY PRE-WEANED (WAD) KIDS FED SOYABEAN DIET AS REPLACER FOR MILK

Age in Weeks:	4			SEM			6			SEM			9			SEM			13			SEM		
Diets:	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Utilization Parameters:																								
(i) Partition of Nitrogen (g/day):																								
Nitrogen intake	1.60 ^a	1.70 ^a	1.60 ^a	0.16	1.90 ^a	1.90 ^a	1.90 ^a	0.21	2.50 ^a	2.50 ^a	2.50 ^a	0.16	2.80 ^a	2.80 ^a	2.80 ^a	0.13								
Faecal nitrogen loss	0.30 ^a	0.50 ^b	0.80 ^c	0.09	0.13 ^a	0.43 ^b	0.83 ^c	0.11	0.09 ^a	0.28 ^b	0.74 ^c	0.06	0.10 ^a	0.33 ^b	0.70 ^c	0.35								
Urinary nitrogen loss	0.08 ^a	0.04 ^b	0.13 ^c	0.03	0.006 ^a	0.03 ^a	0.08 ^b	0.04	0.005 ^a	0.014 ^a	0.06 ^b	0.01	0.004 ^a	0.02 ^a	0.07 ^b	0.04								
Nitrogen retained	1.22 ^a	1.16 ^a	0.67 ^b	1.11	1.76 ^a	1.44 ^a	0.99 ^b	1.00	2.41 ^a	2.21 ^a	1.70 ^b	1.16	2.70 ^a	2.45 ^a	2.03 ^a	1.26								
Nitrogen retained (% of intake)	76.25 ^a	68.23 ^a	41.87 ^b	1.11	96.63 ^a	75.78 ^b	52.11 ^c	1.00	96.40 ^a	88.40 ^a	68.00 ^b	1.16	96.43 ^a	87.50 ^a	72.5 ^b	1.26								
(ii) Partition of energy (Kcal/g DM/day):																								
Dietary energy intake	252.40 ^a	243.20 ^a	209.4 ^b	2.06	324.0 ^a	227.4 ^b	254.5 ^b	2.53	386.9 ^a	360.5 ^{ab}	321.7 ^b	1.86	442.4 ^a	407.9 ^{ab}	369.5 ^b	1.60								
Faecal energy loss	44.8 ^a	74.0 ^b	108.6 ^c	1.03	39.2 ^a	68.9 ^b	95.2 ^c	1.23	18.1 ^a	49.1 ^b	72.1 ^c	0.70	18.1 ^a	34.2 ^b	43.7 ^c	0.76								
Urinary energy loss	2.6 ^a	4.5 ^b	5.9 ^c	0.30	2.3 ^a	4.5 ^b	4.0 ^c	0.26	1.2 ^a	3.1 ^b	2.9 ^a	0.16	0.9 ^a	1.2 ^a	1.84 ^b	0.20								
Digestible energy (DE) intake	207.4 ^a	169.2 ^b	100.7 ^c	1.70	284.8 ^a	208.6 ^b	15.3 ^c	2.36	368.8 ^a	311.4 ^b	249.6 ^c	1.70	424.3 ^a	373.5 ^b	325.8 ^c	1.83								
Metabolisable energy (ME) intake	204.8 ^a	164.7 ^b	94.7 ^c	1.60	282.5 ^a	204.1 ^b	155.3 ^c	2.33	367.6 ^a	308.3 ^b	246.7 ^c	1.70	423.4 ^a	372.3 ^b	323.9 ^c	1.68								

abc Means along the same row within the same age bracket with different superscripts are significantly different ($P < 0.05$).

treatment means compared using the Duncan's Multiple range tests (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The chemical composition of the experimental diets is shown in Table 2. The dry matter (DM) intake (g/day) of the kids (Table 3) fed diets 1, 2 and 3 was not significantly different ($P > 0.05$) but increased ($P < 0.05$) with age of the kids.

The nutrient digestibility values at the various ages is presented in Table 3. Dry matter, crude protein, nitrogen-free extract, ether extract and energy digestibility values recorded by the kids decreased with replacement of milk soyabean diet (SD) up to 50 percent level. The poor DM digestibility observed with partial substitution of SD for milk could be attributed to the high fibre content of SD compared to milk, and probably the presence of indigestible carbohydrates such as arabino galactans, acid poly-sacharide and other pectin - like substances present in soyabeans. Decreased DM digestibility with substitution of soyabean protein for milk protein has previously been reported for calves (Akinyele and Harshbarg, 1983; Silva, Huber and DeGregorio, 1986) and pre-ruminant lambs (Malouf and Walker, 1981).

Decreased crude protein digestibility of the kids with replacement of milk with SD could be attributed to poor abomasal coagulation of soyabean proteins when compared with casein. Similar observations have been made for calves (Gaudreau and Brisson, 1980; Jenkins, 1981). Decreased crude protein digestibility with substitution of soyabean protein observed in this study agrees with previous findings on calves (Pejic and Kay, 1979; Silva *et al*, 1986) and lambs (Malouf and Walker, 1981).

Decreased ether extract digestibility observed in this study may be attributed to the nature of fatty acids present in soyabean. In an earlier study, Gibney and Walker (1977) reported a decreased digestibility of common oil (Olive oil, Sunflower oil, Groundnut oil or coconut oil) with exception of butter oil, when isolated soyabean protein was used instead of dry skim milk. They attributed the favourable

property of butter oil to its high content of low molecular weight fatty acids and in particular butyric acid. Also the partial hydrolysis of butter oil in the abomasum of pre-ruminants by pre-gastric esterase would considerably reduced the substrate load on pancreatic lipase (Gibney and Walker, 1977).

The presence of indigestible carbohydrates and other pectin - like substances in soyabean may be responsible for the lower NFE digestibility observed for the kids on diets containing SD. The data also tend to suggest better utilisation of-lactose than carbohydrate from soyabean and corn starch by the kids. Similar trend has also been reported by Silva *et al* (1986) for suckling calves fed milk replacer in which soyabean protein was substituted for milk protein. The low digestibility of dry matter, crude protein, NFE, and ether extract observed in this study for kids with the partial substitution of SD for milk may be responsible for the decreased energy digestibility recorded.

Replacement of milk with up to 50 percent level had no appreciable effect ($P > 0.05$) on crude fibre digestibility by the kids at 4 weeks of age. Above 4 weeks of age, kids receiving diet containing 50 percent SD had ($P < 0.05$) higher digestibility of crude fibre than those on the diet containing 25 percent SD. This may be attributed to the higher crude fibre intake of animals on diet containing 50 percent SD in early life when compared with those receiving 25 percent SD.

Kids fed whole milk or diets in which 25 percent of milk was replaced with SD retained more nitrogen and recorded higher weight gains compared with those receiving diets containing 50 percent SD. Values recorded for digestible energy and metabolisable energy intake (Table 4) decreased with replacement of milk with SD. This could be attributed to the poor nutrient digestibility observed for kids fed diets in which SD partially replaced whole milk and suggests better utilization of whole milk compared with SD by kids. Reduced weight gains observed in this study with replacement of milk proteins with soyabean proteins agrees with previous reports on calves

(Akinyele and Harshbarger, 1983; Silva *et al*, 1986); lambs (Malouf and Walker, 1981) and kids (Tanabe and Kameoka, 1977).

The results suggested that 25 percent replacement of milk with SD will give adequate performance of pre-weaned kids. However, the replacement level could be increased up to 50 percent as from six weeks of age.

REFERENCES

- AKINYELE, J.O. and K.E. HARSHBARGER (1983) "Performance of young calves fed soyabean protein replacers". *J. Dairy Sci.* 66: 825 - 830.
- ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS (1984). *Official Methods of Analysis* 14th Edition, Washington D.C.
- GAUDREAU, J.M. and G.J. BRISSON (1980) "Abomasum emptying in dairy calves fed milk replacers with vary fat and sources of protein" *J. Dairy Sc.* 63: 426 - 440.
- GIBNEY, M.J. and D.M. WALKER (1977): Milk replacers for pre- ruminant lambs: Protein and carbohydrate interactions. *Aust. J. Agric. Res.* 29: 133 - 144.
- JENKINS, K.J. (1981) "Pepsin and Pancreatin supplementation of calf milk replacer containing soya protein" *Can J. Anim. Sc.* 61: 469 - 477.
- MALOUF, N.M. and D.M. WALKER (1981) "Milk replacers containing soyabean protein isolates or concentrates: Nitrogen digestibility and utilization by pre-ruminant lambs". *Aust J. Agric Res.* 32: 801 - 812.
- MARRIER, J.R. and BOULET, M.J. (1959) "Direct analysis of lactose in Milk and Serum" *J. Dairy Sci.* 42: 1390 - 1391.
- OKAGBARE, G.O and A.O. AKINSOYINU (1996) "Performance of pre- weaned West African dwarf goats fed soyabean diet as replacer for milk". *Nig. J. Anim. Prod.* 24: (1) 57 - 61.
- OPASINA, B.A. (1985) "Health problems among pasture grazed sheep and goats of Fashola in Southwest Nigeria" *Nig. J. Anim. Prod.* 12 (2) 133 - 128.
- PEJIC, N. and KAY (1979) "Soya flour in milk replacers for young calves" *J. Anim. Prod.* 28: 420 - 426.
- SILVA, A.G. J.T. HUBER and R.M. DeGREGORIO (1986). Influence of substituting two types of soyabean protein for milk on gain and utilization of milk replacers in calves. *J. Dairy Sci.* 69: 172 - 180.
- STEEL, R.G.D. and TORRIE, J.H. (1980) *Principles and Procedure of Statistics.* McGraw-Hill, New York.
- TANABE, S. and K. KAMEOKA (1977) "Growth and nutrient utilization by kids fed milk replacers containing isolated soyabean protein as the sole source of protein. *Nutr. Abstract.* 48: 235.
- UPTON, M. (1985) "Models of improving production system for small ruminants sheep and goats in humid West Africa" Proceedings of the Workshop on small ruminant production systems in the humid zone of West African held in Ibadan, Nigeria (J.E. Sumbery and K. Cassaday eds.) 55 - 67.