EFFECTS OF MILK FEEDING ON BLOOD GLUCOSE AND UREA LEVELS OF WEST AFRICAN DWARF (*FOUTA DJALLON*) KIDS.

A.A. AWAH, A.U. MBA and I.O.A. ADELEYE

Department of Animal Science
University of Ibadan, Ibadan, Nigeria.

SUMMARY

SIXTEEN West African dwarf (*Fouta Djallon*) kids were maintained on four dietary treatments from the 4th day to 52 weeks of age in order to study the concentrations of glucose and urea in the plasma with advancing age. The diet comprised fresh cow's milk and fresh goat's milk supplemented with chopped giant star grass (*Cynodon nlemfuensis* var *robustus*) plus creep and post-creep feeds.

Post-absorption glucose concentration was generally higher than the pre-feeding level in all treatment groups. Glucose concentrations in the plasma were generally higher when kids were on milk feeding than when milk feeding was stopped. Kids on *ad. lib.* milk feeding had higher plasma glucose concentration one hour before and after feeding and grew faster than those on restricted amounts of milk feeding. This however tended to level off by the 52nd week of age. The concentration of glucose in the plasma declined consistently with age across all treatment groups.

Kids consuming goat's milk showed a tendency for lower urea concentration in the plasma than those consuming cow's milk.

INTRODUCTION

Wardrop and Coombe (1960) postulated that the rumen of the grazing lamb could be divided into three phases, viz (i) 0 to 3 weeks of age, as a non-ruminant phase, (ii) 3 to 8 weeks of age as a transition phase and (iii) 8 weeks of age onwards as an adult ruminant phase. In addition McCarthy and Kesler (1956) stated that at birth and for a short time afterwards the calf relies on glucose for its major energy needs and that later the glucose levels in the blood began to fall while the concentration of volatile fatty acids in the blood increased. There has been no experimental appraisal on the effect of supplementary milk feeding on the

blood metabolites of the West African dwarf kids and therefore data on such nutritional appraisal are very scanty.

This experiment was designed to study the effect of varying levels of milk feeding supplemented with grass plus concentrate feed on plasma glucose and urea levels of West African dwarf kids with age.

MATERIALS AND METHODS

Sixteen West African dwarf (*Fouta Djallon*) kids ranging from 1.6 to 1.8 kg at birth were subjected to four dietary treatments from the 5th day of life to 52 weeks of age to study the plasma glucose and urea levels at different stages of growth; viz: 2, 8, 12, 24 and 52 weeks of age.

The experimental diet comprised fresh cow's milk and fresh goat's milk, each of which was supplemented with chopped giant star grass (*Cynodon nlemfuensis* var *robustus*) plus creep and post-creep feeds. The creep feed was fed to 12 weeks of age and comprised 31.5% cassava flour, 40% soya bean meal, 20% milled brewers grain, 2.5% sucrose, 5% glucose, 0.5% dicalcium phosphate and 0.5% mineral/vitamin mixture. The post-creep feed was fed from the 13th week of age onwards and comprised 39% cassava flour, 40% soya bean meal, 20% milled brewers grain, 0.5% dicalcium phosphate and 0.5% mineral/vitamin mixture.

Four kids (two males and two females) were randomly assigned to each of four dietary treatments. Kids on treatment I were bottle-fed with fresh cow milk *ad-libitum* and was designated as treatment

CA. Kids on treatment II were bottle-fed with fresh cow-milk at half appetite and was designated as treatment CH. In treatment III the kids were bottle-fed with fresh goat-milk (pooled from the lactating herd) *ad-libitum* and was designated as treatment GA. The kids on treatment IV were allowed to suckle their dams (natural suckling) and was designated as treatment NS.

The mean of the daily milk consumption by kids on cow-milk *ad-lib.* (CA) was used to determine the equivalence of half appetite for kids on treatment CH. The difference between the weight of kids on treatment NS before and after suckling was used to estimate the amount of milk consumed. Kids on treatments CA, CH and GA were bottle-fed with warmed fresh milk at 37°C. All kids were fed at 8.00, 13.00 and 18.00 hours. Chopped grass and creep or post-creep feeds were offered *ad-lib* to all treatment groups once a day during the morning feed. Kids on treatment NS were weaned off milk feeding at about 6 weeks of age while milk feeding was continued with kids on treatments CA, CH and GA to 20 weeks of age. All kids were housed indoors in pens littered with wood shavings and were allowed free access to salt licks and daily fresh water supply.

Sampling of blood:

Samples of blood were taken from each kid 1 hour before and after the morning feed. Blood samples were withdrawn from the jugular vein with sterilized disposable syringes with heparin an anticoagulant. The blood samples were immediately centrifuged at 3000 r.p.m. for 30 minutes to obtain the plasma which was stored in plastic bottles in deep freeze at -5°C until required for analysis.

Analytical procedure:

Glucose in the plasma was estimated by the glucose oxidase method (Hugget and

Nixon, 1957). The Plasma urea content was determined by Fawcett and Scott (1960) method.

RESULTS

Kids on *ad-lib.* milk feeding scoured occasionally; treatment with soluble terramycin stopped the scouring. Kids on treatment NS did not scour when they suckled naturally, but they scoured profusely soon after they were stopped from milk feeding leading to 100% mortality by the 12th week of age.

The summary of dry matter (DM) intake and live-weight of the West African dwarf kids are shown in Table 1. The mean plasma glucose levels (mg/100 ml) determined one hour before and after feeding are shown in Table 2.

Dietary treatments significantly ($P/0.05$) affected the plasma glucose levels 1 hour before and after feeding at 2, 8 and 12 weeks of age. At 2 weeks of age, kids on *ad-lib.* cow-milk feeding (CA) had significantly ($P/0.05$) higher pre-feeding and post-absorption plasma glucose levels than those on *ad-lib.* goat-milk feeding (GA), cow-milk fed at half appetite (CH) and natural suckling (NS). Plasma glucose levels for kids on treatments CH and NS were about the same, but was significantly ($P/0.05$) lower than the value for kids on treatment GA. The pattern of DM consumption was similar to the above mentioned observation. However, there was no significant difference ($P > 0.05$) between the live-weight of the kids at 2 weeks of age.

At 8 weeks of age, the pre-feeding and post-absorption plasma glucose levels for the kids differed significantly ($P/0.05$) in the following order $CA > GA > CH > NS$. Although there was no significant difference ($P > 0.05$) between the DM intakes, yet kids on milk feed *ad-lib* (CA and GA) appeared to be growing faster than those on restricted amounts of milk feeding (CH

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TABLE I

Mean dry matter intake and live-weight for West African dwarf kids maintained on four dietary treatments.

Age	Treatment	Dry matter intake g/day				Live-weight (kg)
		from milk	from grass	from concentrate	total	
2 weeks	CA	67.35 ± 7.050 ^a	0.00	0.00	67.35 ± 7.050 ^a	2.18 ± 0.075
	CH	30.98 ± 4.425 ^c	0.00	0.00	30.98 ± 4.425 ^c	1.96 ± 0.085
	GA	48.28 ± 3.355 ^b	1.15 ± 0.664	0.45 ± 0.330	49.88 ± 3.491 ^b	2.26 ± 0.044
	NS	34.84 ± 3.376 ^{bc}	4.43 ± 0.345	1.93 ± 0.357	40.69 ± 3.911 ^{bc}	2.17 ± 0.217
8 weeks	CA	88.09 ± 18.315 ^a	11.50 ± 1.016 ^a	0.28 ± 0.103 ^b	99.86 ± 17.837	5.00 ± 0.408 ^a
	CH	53.16 ± 3.480 ^b	9.75 ± 1.060 ^a	12.48 ± 4.810 ^b	75.39 ± 6.514	3.16 ± 0.100 ^b
	GA	107.46 ± 7.917 ^a	5.58 ± 1.352 ^b	1.31 ± 0.307 ^b	114.34 ± 8.602	4.30 ± 0.325 ^a
	NS	—	12.44 ± 1.956 ^a	86.34 ± 13.227 ^a	98.78 ± 13.979	2.97 ± 0.447 ^b
12 *weeks	CA	134.38 ± 9.041 ^a	9.23 ± 0.749	25.98 ± 22.900 ^b	169.59 ± 14.518 ^a	6.24 ± 0.263 ^a
	CH	63.72 ± 0.000 ^b	15.73 ± 3.217	36.25 ± 16.467 ^a	115.69 ± 19.573 ^b	4.68 ± 0.420 ^b
	GA	130.86 ± 2.369 ^a	10.43 ± 0.544	5.50 ± 1.892 ^c	146.79 ± 4.506 ^a	5.95 ± 0.029 ^a
24 *weeks	CA	—	25.47 ± 6.599	206.06 ± 15.389 ^a	231.56 ± 21.681 ^a	8.84 ± 0.734 ^a
	CH	—	27.05 ± 4.062	118.13 ± 0.000 ^c	143.18 ± 4.062 ^b	5.63 ± 0.361 ^b
	GA	—	24.43 ± 1.209	158.10 ± 9.537 ^b	182.53 ± 10.630 ^b	8.05 ± 0.260 ^a
52* weeks	CA	—	28.37 ± 6.294	358.84 ± 35.964 ^a	387.21 ± 37.536 ^a	13.53 ± 0.353 ^a
	CH	—	24.79 ± 3.576	235.69 ± 9.826 ^b	260.48 ± 7.162 ^b	9.92 ± 0.563 ^b
	GA	—	36.07 ± 2.248	292.05 ± 22.294 ^{ab}	329.40 ± 24.086 ^{ab}	11.32 ± 0.078 ^b

* = kids on treatment NS did not survive at ages indicated.

- = No milk feed was offered.

Mean values with same superscript in a column and within same age group are not significant ($P > 0.05$)

CA = Cow-milk ad-lib.; CH = cow-milk half appetite; GA = goat-milk ad-lib; NS = natural suckling.

and NS).

At 12 weeks of age, kids on treatments CA and GA had about the same levels of glucose in the plasma, DM intake and live-weight which were also significantly ($P/0.05$) in the plasma glucose levels between treatment groups at 24 and 52 weeks of age. Kids on treatment CA had significantly ($P/0.05$) higher DM intake than kids on treatments GA and CH at 24 weeks of age, but the mean live-weights of kids on treatments CA and GA were similar and were significantly ($P/0.05$) heavier than kids on treatment CH. At 52

weeks of age, the DM consumption by kids on treatments CA and GA were about the same but the mean live-weight of kids on treatment CA was significantly ($P/0.05$) heavier than those on treatments GA and CH.

It was generally observed that the plasma glucose levels 1 hour after feeding were significantly ($P/0.05$) higher than the pre-feeding levels for all treatment groups at 2 weeks of age. Except the kids on treatment NS, the post-feeding plasma glucose levels for the kids on treatments CA, CH and GA were again significantly

TABLE 2

Mean blood glucose levels for West African dwarf kids at various stages of growth maintained on four dietary treatments.

AGE (weeks)	TREATMENT	MEAN PLASMA GLUCOSE LEVELS Mg/100 ml.	
		1 hr. before feeding	1 hr. after feeding
2	CA	77.71 ± 1.289 ^a	90.94 ± 0.960 ^a
	CH	65.31 ± 0.995 ^c	79.90 ± 0.699 ^c
	GA	70.59 ± 0.721 ^b	83.74 ± 0.631 ^b
	NS	64.88 ± 1.582 ^c	85.27 ± 1.300 ^c
	MEAN	69.62 ± 2.922	84.96 ± 2.290
8	CA	78.52 ± 0.903 ^a	89.89 ± 0.798 ^a
	CH	63.87 ± 1.555 ^c	72.91 ± 1.842 ^c
	GA	70.75 ± 0.738 ^b	82.12 ± 0.727 ^b
	NS	56.30 ± 3.755 ^d	58.75 ± 3.781 ^d
	MEAN	67.36 ± 4.748	75.92 ± 6.692
12*	CA	73.18 ± 1.343 ^a	85.68 ± 1.056 ^a
	CH	62.21 ± 1.991 ^b	68.73 ± 1.252 ^c
	GA	68.57 ± 0.973 ^a	79.82 ± 1.250 ^b
	MEAN	67.99 ± 3.180	78.08 ± 4.970
24*	CA	57.34 ± 0.778	57.63 ± 0.764
	CH	53.33 ± 1.780	55.42 ± 0.944
	GA	56.31 ± 0.683	76.78 ± 0.972
	MEAN	55.66 ± 1.202	56.61 ± 0.644
52*	CA	52.98 ± 1.108	55.96 ± 1.018
	CH	53.36 ± 1.607	44.87 ± 1.518
	GA	53.60 ± 2.273	54.80 ± 2.224
	MEAN	53.96 ± 0.505	55.21 ± 0.409

* = Kids on treatment NS did not survive at ages indicated.

Mean values with same superscript within same age in a column are not significant ($P > 0.05$).

CA = Cow-milk *ad-lib.*; CH = Cow-milk half appetite; GA = goat-milk *ad-lib.*; NS = Natural Suckling.

($P > 0.05$) higher than the pre-feeding levels at 8 weeks of age. Thus, there was no significant ($P > 0.05$) difference between the pre-feeding and post-absorption plasma glucose levels for kids on treatment NS at 8 weeks of age. Except again the kids on treatment CH, the post-feeding plasma glucose levels for the kids on treatments CA and GA were significantly ($P > 0.05$) higher than the pre-feeding levels at 12 weeks of age.

However, at 24 and 52 weeks of age, the post-feeding plasma glucose levels were slightly higher than the pre-feeding levels, but the differences between these levels were not significantly different ($P > 0.05$) from one another.

A study of age effect on the plasma glucose levels showed that the levels of glucose in the plasma consistently declined with advancing age. Apart from the kids on treatment NS, the decline in the

level of glucose in the plasma between the ages of 2 and 8 weeks were significant ($P/0.05$). The decline in plasma glucose levels between 8 and 12 weeks of age and between 12 and 24 weeks of age were also significant ($P/0.05$). The decline in plasma glucose levels between 24 and 52 weeks of age did not differ significantly ($P < 0.05$) from one another.

The pattern of plasma urea levels one hour before and after feeding (Table 3) for all treatment groups do not lend itself to easy interpretation. There was a persistent tendency for the plasma urea levels of kids fed cow's milk to be higher than the value for kids fed goat's milk.

were on milk feed (2 to over 12 weeks of age) the plasma glucose concentration increased very remarkably one hour after feeding than the increases observed when milk feed was stopped (24 and 52 weeks of age). Barhydt and Dye (1957) observed that the rate of flow of liquid milk from the abomasum to the duodenum was fairly rapid and Davis and Brown (1962) reported that virtually all the milk lactose was quickly digested and absorbed from the small intestine and rapidly utilized by the animal. The reports by the above-mentioned authors may have been the reasons for the very high post-absorption plasma glucose levels observed from the

TABLE 3

Mean blood urea levels for West African kids at various stages of growth maintained on four dietary treatments.

AGE (weeks)	TREATMENT		MEAN PLASMA UREA LEVELS Mg/100 ml.	
		1 hr. before feeding		1 hr. after feeding
2	CA	11.06 $\pm$ 2.872		3.42 $\pm$ 1.323
	CH	5.25 $\pm$ 2.306		3.96 $\pm$ 1.047
	GA	2.11 $\pm$ 0.346		3.36 $\pm$ 0.653
	NS	1.27 $\pm$ 0.045		1.46 $\pm$ 0.320
	MEAN	4.92 $\pm$ 2.218		2.80 $\pm$ 0.553
8	CA	10.60 $\pm$ 7.791		7.13 $\pm$ 5.565
	CH	11.72 $\pm$ 3.539		10.03 $\pm$ 4.389
	GA	2.30 $\pm$ 0.234		2.25 $\pm$ 0.078
	NS	7.13 $\pm$ 4.538		6.14 $\pm$ 2.926
	MEAN	7.94 $\pm$ 2.118		6.39 $\pm$ 1.607
12*	CA	7.97 $\pm$ 3.354		8.44 $\pm$ 4.087
	CH	6.97 $\pm$ 2.722		6.80 $\pm$ 2.654
	GA	4.50 $\pm$ 0.548		4.69 $\pm$ 0.688
	MEAN	6.31 $\pm$ 1.005		6.64 $\pm$ 1.085
24*	CA	8.78 $\pm$ 0.360		8.62 $\pm$ 0.373
	CH	6.90 $\pm$ 0.749		6.89 $\pm$ 0.638
	GA	6.39 $\pm$ 0.234		6.75 $\pm$ 0.188
	MEAN	7.36 $\pm$ 0.727		7.42 $\pm$ 0.601
52*	CA	5.77 $\pm$ 4.580		5.82 $\pm$ 0.568
	CH	6.02 $\pm$ 0.395		6.30 $\pm$ 0.175
	GA	5.41 $\pm$ 0.487		5.62 $\pm$ 0.464
	MEAN	5.73 $\pm$ 0.177		5.91 $\pm$ 0.202

* = Kids on treatment NS did not survive at ages indicated.

CA = Cow-milk *ad-lib.*; CH = Cow-milk half appetite; GA = goat-milk *ad-lib.*; NS = Natural suckling.

DISCUSSION

The results showed that when the kids

present study. Kids consuming milk feed *ad-lib.* consequently consumed more dry

matter from milk and had the highest plasma glucose levels one hour before and after feeding.

The higher plasma glucose levels one hour after feeding observed in this study is in agreement with reports by Doller and Porter (1957) and Ndumbe, Runcie and McDonald (1964) who observed that blood glucose rose rapidly after a meal to a peak at about 2 hours after feeding and then declined to the pre-feeding levels about 5 hours after feeding. The highest peak levels of 90.94 ± 0.960 , 89.89 ± 0.798 and 85.68 ± 1.056 mg/100ml. at 2, 8 and 12 weeks of age respectively for kids on treatment CA were however very much lower than the values obtained by Ndumbe *et al.* (1964) at 2, 6, 8 and 12 weeks old respectively for calves one hour after feeding.

Hibbs, Conrad and Pounden (1952) stated that the plasma glucose levels in animals given antibiotics were higher than in control animals. The high plasma glucose levels observed in this study up to 12 weeks of age with kids on treatments CA and GA in particular could be due to the inclusion of soluble terramycin to check scouring. In addition Ndumbe, *et al.* (1964) observed that plasma glucose level declined markedly only after withdrawal of milk feed from the diet. The decline in plasma glucose level with advancing age reported in this work is in agreement with the findings of Dye and Orsini (1952) Ndumbe *et al.* (1964), Reid (1953) and Hibbs *et al.* (1952). Vandersal, Conrad and Hibbs (1957) stated that the decline in plasma glucose concentration was associated with the replacement of foetal erythrocytes high in glucose with erythrocytes of lower concentration or possibly also due to an increase in the production of VFA as was suggested by Liang, Morrill and Noordsy (1967).

The inconsistent results for plasma urea in this study might be due to the time of sampling of blood, since Lewis (1957) reported that high blood urea level oc-

cured 6 to 7 hours after feeding. The tendency for kids on goat's milk having lower plasma urea concentration might be due to faster rate of utilization of goat-milk by the kids.

In conclusion, kids on *ad-lib.* milk feeding had significantly higher concentration of glucose in the plasma and grew faster than those on restricted amounts of milk feeding. The post-absorption plasma glucose concentration was generally higher than the pre-feeding level both of which consistently declined with advancing age. Prolonged milk feeding resulted in high plasma glucose concentration, hence could delay the onset of rumen fermentation in the young ruminant. Kids consuming goat-milk showed lower concentration of urea in the plasma than those consuming cow milk, although much work is still needed to confirm this observation.

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