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THE EFFECT OF DIETARY VITAMIN A SUPPLEMENTATION ON SOME BIOCHEMICAL CHARACTERISTICS OF SERUM IN GRAVID LARGE WHITE GILTS

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ABSTRACT

Semen biochemical characteristics of the sera of gravid Large White gilts fed either a basal diet containing 4,000 IU of vitamin A/kg of feed (11 gilts) or the same diet without vitamin A supplementation (10 gilts), were evaluated. The sera were separated from their respective blood samples obtained 35 days *post coitum*. The results showed similarities (P>0.05) between the diets in serum total protein while serum glucose levels differed significantly (P>0.05) between the diets. Besides the significant difference (P<0.05) between the diets in serum manganese levels, all other serum electrolytes were similar between the diets. These results imply that the vitamin a content of basal rations for swine is adequate for normal body functions and reproduction. Vitamin A supplementation during gestation would therefore be unnecessary if the animals are on a good plane of nutrition.

KEYWORDS: Vitamin A; Supplementation; Biochemical Characteristics; Serum; Gilts.

INTRODUCTION

The critical roles that vitamin A plays in regulating reproduction in the female have for long been documented (Lotthammer, 1979; Briefs and Chew, 1985 and Chew, 1993). Besides the generalized effect of vitamin A on the epithelial tissues in animals, a deficiency in female animals causes the vaginal epithelium to become cornified, which may result in irregularity of oestrus and delayed breeding (Yakimchuk, 1974) Major disturbances in the female occur during the latter part of gestation, resulting in abortion or the birth of weak, blind or dead malformed offspring in pigs (Palludan, 1975).

Besides the adequate provisions of vitamin, A in balanced rations to pigs under the intensive system of management, most animals are able to convert β – Carotene from plant sources like yellow maize to vitamin A at the lining of the intestinal wall (Chew, 1993). Also owing to the presence of retinol – binding protein (RBP) in uterine secretions from pigs in the luteal phase of the oestrous cycle being different from serum and cellular RBP in it's binding affinity for retinol (Adams et al., 1981), it becomes necessary for us to evaluate the effect of dietary vitamin A supplementation on some biochemical characteristics of serum during early gestation especially when the basal diet contains enough vitamin A to prevent a marked deficiency and where the supplementation level is not too high to cause toxicity. This work was therefore designed to provide basic information on the effect of dietary vitamin A supplementation on some biochemical characteristics of serum in Large White gilts following their first oestrus and gestation.

MATERIALS AND METHODS

Animals, Diets and Management: Twenty-one pubertal Large White gilts 5-6 months of age and weighing 16.50-47.okg were used for this investigation. They were randomly distributed into two dietary treatment groups having been equalized in age and weight. Treatment I, consisting of 11 gilts received a basal diet (Table1) compounded and supplemented with 4,000 IU of vitamin A per kg of feed, while the control group (diet 2) consisting of 10 gilts was fed the same basal diet compounded without vitamin A supplementation. Each group was housed separately in a standard dwarf-walled, open air, concrete floored pig pen. The animals were fed *ad libitum* and had access to cool clean drinking water always.

Vitamin A content of the diets: The total vitamin content of the diets was estimated to be 12373.80 IU and 16, 373.80 IU for the unsupplemented and supplemented diets respectively.

Puberty: The gilts were closely observed for oestrus twice daily at 0800 and 1800h. Four boars which had previously been used successfully for breeding were used interchangeably between the groups for teasing and service. Gilts that came on heat (first oestrus) were weighed and bred by hand mating on the first and second days of oestrus, and were thereafter allowed to continue on the respective diets. The duration the animals stayed on the test diets covered the phase from the commencement of feeding to the attainment of puberty and 35 days post contium after which each animal was sacrificed.

Blood collection: Blood samples were collected at slaughter from the severed jugular vein into plain test tubes without an anticoagulant. The sera were then separated by standard laboratory procedures and stored at - 20^{0}C pending analysis.

Biochemical analysis: Serum total protein was analysed by the standard biuret method according to the Boethringer Diagnostic Assays' Manual (1979), while serum glucose was determined by the O – toluidine colorimetric method as outlined in the Boehringer Diagnostic Assay's manual (1979). Serum mineral levels were determined by standard Flame Photometry procedures. Calcium, magnesium, copper, iron, manganese and zinc were determined by flaming in a perkin – Elmer atomic absorption spectrophotometer 703, using different lamps; while sodium and potassium were determined using a Corning 400 photometer.

Statistical analysis: The data obtained were subjected to the student 't' test (Steel and Torrie, 1960).

RESULTS

The compositions of the experimental diets are presented in Table 1, while the effect of dietary vitamin A supplementation on serum biochemical characteristics is summarized in Table 2.

While serum total protein concentrations were similar between the diets (8.50± 0.31 g/100 ml and 8.604± 2.34 g/100 ml for diets 1 and 2 respectively), serum glucose levels differed significantly (p<0.05) between the diets, the supplemented diet having higher values (40.764 ± 13.52 g/100ml) than the unsupplemented diet (14.441 ± 5.28 g/100ml).

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Besides the significant difference (p<0.05) between the diets in manganese levels in the blood (0.00 ± 0.00mg/looml in the supplemented diet and 0.011± 0.00mg/looml in the unsupplemented diet) all other electrolytes were similar between the diets. Values were for calcium 0.236 ± 0.03mg/looml and 0.192 ± 0.017mg/looml for diets 1 and 2 respectively; magnesium: 0.04 ± 0.001mg/looml and 0.053 ± 0.001mg/looml for diets 1 and 2 respectively; postassium: 0.59 ± 0.021mg/looml and 0.815 ± 0.12mg/looml for diets 1 and 2 respectively while sodium levels were for diet 1, 2.12 ± 0.13mg/looml and 2.21 ± 0.094mg/looml for diet 2. The concentration of iron averaged 0.199 ±0.009mg/looml for diet 1 and 0.255±0.07mg/looml for diet 2. Others were: copper: 0.075 ±0.008mg/looml and 0.070±0.008mg/looml for diets 1 and 2 respectively and zinc: 0.056±0.003mg/looml and 0.123±0.03mg/looml for diets 1 and 2 respectively.

DISCUSSION

Dietary vitamin A supplementation in the present study had no effect on serum total, protein concentration (p>0.05), indicating that the basal diet with a total of about 12,373.80 IU of vitamin A per kg of feed (as compared to 16, 373.80 IU/kg of feed in the supplemented diet) would support normal growth and development of tissues and organs as well as physiological and reproductive processes in the body. On the other hand the significant effect of diet on serum glucose levels with the vitamin A supplemented diet having about three times the concentration in the unsupplemented diet suggests a higher energy availability to tissues and organs for animals on the supplemented diet for various body processes, including reproduction. The significant increase in blood glucose levels following vitamin A supplementation may however not be of clinical importance as the glucose levels in the sera of the animals in both diets in the present study were much lower than the normal blood glucose levels reported for pigs (Swenson, 1982).

With regard to serum electrolytes, apart from manganese levels which were significantly higher in the unsupplemented group, all other electrolytes were unaffected by treatment. The higher level of manganese in the control group may however not necessarily imply differences in growth and bone formation in these animals, since the symptoms associated with Mn deficiently were not observed in any of the animals throughout the period of the experiment. The complete absence of Mn in the blood of the animals on the vitamin A supplemented diet is nevertheless hard to explain. It may probably imply either the inability of the analytical technique to detect residual Mn in the blood of the animals in the supplemented group (which appears to be highly unlikely), or an interaction of vitamin A and Mn in the body.

Even though manganese plays many important roles in the body, the most important function of Mn is to activate several enzymes concerned with carbohydrate, fat and protein

Table 1: Composition of basal diet

Ingredient	Percentage
Maize (yellow)	71.40
Groundnut cake	6.20
Brewers Grains	14.90
Blood meal	1.60
Bone meal	1.50
Fish meal	2.80
Oyster shell	1.00
Minovit supper*	0.10
Salt (Nacl)	0.50
Total	100.00

Supplementation	Treatment (vitamin A)	
	Supplemented	unsupplemented
Rovimix A **	4, 000 IU/kg	0.00 IU/kh
Rovimix D ***	500 IU/kg	500 IU/kg
Zinc oxide	0.1g/kg	0.1g/kg

* Minovit super contains in 1kg the following; vitamin A, 7.5 million IU., vitamin D_3 1.5 million I.U; vit B_1 1000mg vit B_2 2.75g, vit B_{12} 5mg; D-calcium phosphate, 5g; vit E, 2.5g; vit K 1.50g Niacine 12.5g; Choline chloride 60g; ethoxyquin 5g; manganese oxide 16.13g; potassium iodide 353mg; cobalt sulphate 28mg; zinc oxide 12.5g; copper oxide 1,283mg; Ferros carbonate 20.323g; (Minovit super – Intervet International B.U. Boxmeer – Holland).

** Rovimix A-500 contains in 1g: 500, 000 IU vit. A

*** Rovimix D-500 contains in 1g; 500, 000 vit D_3 .

Table 2: Effect of dietary vitamin A supplementation on serum total protein, glucose and electrolytes (Means ± sem)

Parameter	Vitamin A Supplementation level / kg feed		
	Treatment 1	Treatment 2	
	4,000 IU	0.000 IU	
Total protein (g/100ml)	8.502 ± 0.31	8.604 ± 2.34	ns
Glucose (g/100ml)	40.764 ± 13.52	14.441 ± 5.28	P <0.001
Calcium (mg/100ml)	0.236 ± 0.03	0.192 ± 0.017	ns
Manganese (mg/100ml)	0.00 ± 0.00	0.011 ± 0.00	P<0.05
Magnesium (mg100ml)	0.04 ± 0.001	0.053 ± 0.001	ns
Potassium (mg/100ml)	0.59 ± 0.021	0.815 ± 0.12	ns
Sodium (mg/100ml)	2.12 ± 0.13	2.21 ± 0.09	ns
Iron (mg/100ml)	0.199 ± 0.009	0.255 ± 0.07	ns
Copper (mg/100ml)	0.075 ± 0.008	0.070 ± 0.008	ns
Zinc (mg/100ml)	0.056 ± 0.003	0.123 ± 0.035	ns

ns = not significant
sem = standard error of mean

metabolism (Campbell and Lasley, 1985). How Mn does these is still a subject of investigation, but it is reported in humans that there is a frequent deficiency of Mn in diabetics (Wright, 1984). It does appear therefore that elevated sugar levels in the blood depress Mn levels as observed in the present study. Further work is required to elucidate the relationship between vitamin A and Mn in the body. The low levels of Mn in the unsupplemented group is expected as Mn although distributed throughout he body, has a total quantity that is much lower than that of other elements (Hays and Swenson, 1982).

All the other serum electrolytes studied were similar between the diets and as such imply normal physiological responses like bone formation, muscle contraction, blood cloting, enzyme activation, erythropoiesis and reproduction as well as acid – base and water balance in the body when gravid gilts and or sows are raised on vitamin A fortified rations. Vitamin A supplementation may therefore be unnecessary.

CONCLUSION

These results demonstrate that the vitamin A content of normal swine rations in the humid tropics may be sufficient to support normal physiological functions in the body.

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