ORIGINAL ARTICLE

SERUM LIPID PROFILES AND ATHEROGENIC INDEX IN PREGNANT SAHEL GOATS: PUBLIC HEALTH IMPLICATIONS

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ABSTRACT

Background: Goat meat is very popular and has a great demand all over Nigeria. However, the slaughter of pregnant goats in abattoirs and slaughter slabs for meat is becoming a serious concern not only for future livestock population, but also for public health. Dyslipidaemia of pregnancy in meat animals may constitute threat to consumers in terms of cardiovascular risks.

Objectives: The purpose of this study was to investigate the concentrations of serum lipids at different stages of gestation in Sahel goats and to evaluate the atherogenic capacity of the lipid profile.

Materials and Methods: Serum lipids profiles and atherogenic indices in pregnant and non-pregnant Sahel goats were studied. Fourteen apparently healthy adult Sahel goats comprising 12 does with mean gestation length of 148.33 ± 1.52 days and 2 bucks were used for the study. They were managed in the University of Maiduguri livestock research farm on low fat diet. Sera samples were collected biweekly for 5 months and were used for the analysis of total Cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL-c), low density lipoprotein (LDL-c) and very low density lipoprotein (VLDL-c). Atherogenic indices were calculated as base 10 log (TG/HDL-c).

Results: Serum TG and VLDL-c concentrations increased significantly ($p < 0.05$) in pregnant does compared to non-pregnant. HDL-c and LDL-c concentrations did not vary significantly ($p > 0.05$) between the two groups. Atherogenic indices increased progressively with advancing pregnancy compared to non-pregnant.

Conclusion: It was concluded that atherogenic capacity of the lipid profile in pregnant Sahel goats is high and therefore consumption of meat from pregnant animals has high potential for atherogenic risk. Routine antemortem inspection should be conducted at abattoirs to identify pregnant animals for restriction against slaughter. Legislation prohibiting the slaughter of pregnant animals should be enforced.

KEYWORDS: Sahel goats, lipid profile, pregnancy, meat, public health, atherogenic indices

INTRODUCTION

Meat constitutes the foremost animal product that is highly explored by Nigerians particularly for direct consumption. Goat meat (chevon) constitutes the major and cheapest source of meat consumption for most households in Nigeria[1]. It is very popular all over Nigeria and has a great demand in restaurants and hotels[2,3,4]. This may not be unconnected with the relatively cheaper cost of goats compared to other animals.

Among the main goat breeds in Nigeria, Sahel goat breed is found more predominantly in the Northern Nigeria, particularly in the arid Sahel region of the country[5]. Nevertheless, excess consumption of high amounts of saturated fatty acids or fat found in some categories of

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meat can affect the consumer serum or tissue lipid profile[6,7]. One of such meat categories is meat from pregnant animals. The slaughter of pregnant animals in abattoirs and slaughter slabs for meat is becoming a serious concern not only for future livestock population, but also for public health. Recent data indicated that 57.85% does slaughtered at Jos and Bauchi abattoirs were pregnant[8] and that 1 out of 4 does slaughtered at Kano abattoir was pregnant[9]. As pregnancy is a dynamic physiological state, it is associated with a broad series of metabolic adaptations which also influence the metabolism of lipids and lipoproteins[10]. Different concentrations of lipid fractions can be found at different stages of pregnancy.These lipid profiles may increase risk for developing obesity and cardiovascular disease or other similar diseases[6].

It is well known that the incidence and nature of atherogenicity in humans is affected by coexistence of other diseases or disorders such as the autoimmune diseases, systemic lupus erythematosus (SLE), rheumatoid arthritis, obesity, diabetes and chronic renal disease[11,12,13,14]. Thus, the public health impact of an increase in the risk of cardiovascular disease as a result of high fat diet is multidimensional. Besides attempts to identify new risk factors, prevention of cardiovascular risk factors such as dyslipidaemia should become a priority or public health concern.

In view of the increasing consumption of meat from pregnant animals, the purpose of the present study was to investigate the concentrations of serum lipids at different stages of gestation in Sahel goats and to evaluate the atherogenic capacity of the lipid profiles. Because of analytical precision[12], we choose to use the atherogenic index of plasma (AIP), defined as the base 10 logarithm of the ratio of plasma triglyceride (TG) to high density lipoprotein cholesterol (HDL-c) as a predictor of atherogenic risk. AIP is based on two important parameters TG and HDL-c, both of which are independent risk factors for cardiovascular disease[15].

MATERIALS AND METHODS

Experimental Animals

Fourteen apparently healthy adult Sahel goats comprising 12 does and 2 bucks were used for this study. The animals were purchased from KasuwaShanu Livestock Market and private farms within Maiduguri Metropolis. The ages of the does ranged between 1½ and 2½ years (based on dentition and breeding history[16]) and weighed between 20-25 kg, while that of the bucks ranged between 2-3 years and weighed between 20-30kg. The Body Condition score (BCS) between 3.0-3.5 was maintained throughout the period of the experiment in all the animals. Breeding history, abdominal palpation and ballottement, nature of mammary secretions, conditions of udder were used in selecting non- pregnant ones[17,18]. The animals were allowed to acclimatize for 4 weeks before the commencement of the experiment. They were managed intensively in the University of Maiduguri livestock research farm. The feed rations consisted of low fat diet (wheat offals, beans husks and hay from groundnut leaves and grasses). Mineral salt licks and water were provided *ad libitu*m. During the stabilization period, the animals were treated with oxytetracycline LA (Introxin-200®, Interchiemie, Venray, Holland) at 20mg/kg body weight and ivermectin (paramectin®, Pharma Swede, Egypt) at 200µg/kg body weight. The males and the females were initially kept in different pens until the time of service.

Estrus Synchronization and animal grouping

The does were synchronized using a synthetic analogue of prostaglandin $F_2\alpha$ (cloprostenol, Estrumate®, Schering-Plough Animal Health, Germany), at 250µg/kg administered twice to each doe intramuscularly at 11 days interval, as previously reported[19]. The animals were teased with apronned males daily. The does that came into estrus after the second treatment were randomly separated into two groups of six each. Does in the pregnant (PGN) group were allowed to be served naturally by the males

and were tagged as pregnant group. The days of service were considered as day 0 of the gestation. Pregnancies were later confirmed by failure to return to estrus and ultrasonograhic examination of the doe using Draminski Ultrasound Pregnancy Detector (UPD-PD032013EX-1.2, Draminsky Agricultural Engineering Co. Inc., Owocowa-Olsztyn, Poland). The animals in the non-pregnant (NPN) group were not served by the males.

Sample Collection and Analysis

Five ml of overnight fasting blood samples was collected from day 0 and thereafter on biweekly basis in each animal through jugular vein at the same day with minimal excitement. The blood samples were placed in sample tubes without anticoagulant and the blood was allowed to clot and centrifuged at 3000 rpm for 5 minutes. The sera were harvested and stored at -20^{0}C before used. Sera were used for the analysis of total Cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL-c), low density lipoprotein (LDL-c) and very low density lipoprotein (VLDL-c) using standard commercial kits (Randox Laboratory Limited, Ardmore, UK).

Total Cholesterol (TC) concentrations were determined by enzymatic end point saponification method as described by Roeschlau*et al*[20], Triglycerides (TG) levels were determined by colorometric method as described by Tietz[21]. High density lipoprotein cholesterol (HDL-c) were assayed by spectrophotometry by means of the coupled reactions in the presence of phosphotungstic acid and magnesium chloride as described by Grove[22] and modified by Harris *et al.*[23]. Low density lipoprotein cholesterol (LDL-c) was determined and calculated by Friedewald's formula[24] as modified by Sood[25], very low density lipoprotein cholesterol (VLDL-c) was calculated using standard formula as described by Henry[26] and modified by Igweh*et al.*[27].The atherogenic index of plasma (AIP), defined as the base 10 logarithm of the ratio of plasma triglyceride (TG) to high density lipoprotein cholesterol (HDL-c), has been employed as a predictor of atherogenic risk.

Statistical Analysis

Data collected were pooled on a monthly basis and expressed as Means ± S.D. One-way analysis of variance (ANOVA) was used to analyzed for significant changes among the different reproductive stages and the differences between the pregnant and non pregnant groups were compared using Student's t – test. Significant differences were considered at ($p < 0.05$). Statistical Software package, GraphPadInStat® (2003) was used for the analysis.

RESULTS

The changes in mean serum concentrations of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c) as well as atherogenic indices in both pregnant and non pregnant Sahel goats are presented in Table 1.

Total cholesterol (TC) concentrations did not vary significant ($p > 0.05$) between the pregnant and non–pregnant groups during first half of gestation, however, significant ($p < 0.05$) decrease was observed during the last trimester compared to control. Serum triglycerides (TG) concentrations increased significantly ($p < 0.05$) during the entire gestational period of gestation compared to control. High density lipoprotein cholesterol (HDL-c) and low density lipoprotein cholesterol (LDL-c) concentrations did not vary in both groups. Very low density lipoprotein cholesterol (VLDL-c) continued to increase significantly ($p < 0.05$) during entire gestational period compared to control. The atherogenic index of plasma (AIP) increased significantly ($p < 0.05$) during 2nd and 3rd trimesters of gestation compared to non-pregnant or control. Parturition occurred on day 147, 148 and 150 of gestation in one, two and three does respectively. The mean gestation length was 148.33 ± 1.52 days.

Table 1: Serum Lipid profiles and Atherogenic Index in pregnant Sahel goats

		Periods of Observation (Months)					
Parameters	Group*	0	1	2	3	4	5
TC(mmol/L)	PGN	1.68±0.22	1.68±0.21	1.68±0.20	1.66±0.23[b,d]	1.57±0.21[b,d]	1.56±0.24[b]
	NPN	1.67±0.23	1.68±0.23	1.68±0.22	1.68±0.22	1.68±0.20	1.68±0.26
TG(mmol/L)	PGN	1.51±0.27	1.57±0.20[a,c]	1.62±0.21[a,c]	1.66±0.23[a,c]	1.65±0.26[a]	1.66±0.25[a]
	NPN	1.51±0.27	1.50±0.22	1.51±0.23	1.52±0.24	1.51±0.24	1.52±0.25
HDL(mmol/L)	PGN	1.27±0.25	1.27±0.21	1.27±0.24	1.27±0.24	1.27±0.20	1.27±0.22
	NPN	1.27±0.26	1.27±0.23	1.27±0.24	1.27±0.25	1.27±0.23	1.27±0.21
LDL(mmol/L)	PGN	0.93±0.03	0.93±0.02	0.93±0.03	0.93±0.01	0.92±0.04	0.93±0.01
	NPG	0.93±0.02	0.93±0.01	0.92±0.03	0.93±0.00	0.92±0.03	0.93±0.02
VLDL	PGN	0.69±0.02	0.72±0.01[a,c]	0.74±0.02[a,c]	0.76±0.03[a,c]	0.76±0.03[a]	0.77±0.03[a]
(mmol/L)	NPN	0.68±0.01	0.69±0.02	0.69±0.03	0.69±0.03	0.69±0.04	0.69±0.02
AIP	PGN	0.08±0.01	0.09±0.02	0.11±0.01[a]	0.12±0.01[a]	0.11±0.02[a]	0.12±0.04[a]
	NPN	0.08±0.02	0.07±0.01	0.08±0.03	0.08±0.02	0.07±0.01	0.08±0.03

Keys: PGN = Pregnant; NPN = Non pregnant (Control); TC = Total cholesterol; TG= triglycerides; HDL= high density lipoprotein; LDL= low density lipoprotein; VLDL= very low density lipoprotein; AIP = Atherogenic Index of Plasma *N= 6 for both groups

[a]=Significant ($p<0.05$) increase compared to respective control group [b]=Significant ($p<0.05$) decrease compared to respective control group

[c]= Significant ($p<0.05$) increase compared to preceding gestational stage [d] =Significant ($p<0.05$) decrease compared to preceding gestational stage

DISCUSSION

The determinants of lipid profile include total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c). TG plays the role of a regulator of lipoprotein interactions[28]. There is increased evidence that an increased plasma concentration of TG is associated with increased incidence of coronary artery disease[28] and an increased population of VLDL-c[29]. TG has also been proposed to be a major determinant of cholesterol esterification/transfer and HDL remodeling in human plasma[30].

The increase in TG and VLDL-c in pregnant Sahel goats in this study could be as a result of heavier transport of the lipoproteins in the pregnant goats compared to non-pregnant. During pregnancy, hormone-sensitive lipase (HSL) activity in adipose tissue is enhanced and stimulates triglyceride (TG) and VLDL-c production in liver[31,32]. The synthesized lipoproteins (VLDL-c) and TG are exported from the liver to plasma for circulation to other target tissues[31]. Because of decrease in the activity of lipoprotein lipase, VLDL-c remains in the plasma for long and leads to the accumulation of VLDL-c, TG and TC[33]. However, the observed decrease in total cholesterol (TC) concentration in the 3rd trimester may be due to shift in steroidogenesis whereby cholesterol is being used for synthesis of estrogen and also for calorigenesis[34] and hence masked the TC levels. Similar tendency was observed in women[39], cows[40] and sheep[41].

Atherogenic indices are powerful indicators of the risk of heart disease[35].Elevated serum TG and VLDL-c concentration is usually associated with thrombogenic and atherogenic effects in humans[36,37]. The observed increase in atherogenic index in pregnant Sahel goats in this study may be due to increase in TG and VLDL-c concentrations. Indeed, elevated levels of TG and VLDL-c have been associated with an increased incidence of cardiovascular diseases[28,38]. In this study, we observed that atherogenicity of the lipid profiles increased progressively with advanced pregnancy. This is attributable to the dyslipidaemia of pregnancy which was characterized by elevated plasma levels of triglycerides and VLDL-c in this species. The atherogenic indices were categorized according to atherogenic risk values, as described by Holme*et al*.[38], into: Low risk < 0.11, Intermediate risk 0.11-0.2 and Increased risk > 0.2. The data suggest that the atherogenic capacity of the lipid profile in pregnant Sahel goats is between intermediate and increased risk. Therefore consumption of meat from pregnant goats has potential of detrimental effects on vascular functions.

CONCLUSION AND RECOMMENDATION

In conclusion, the present study indicated that atherogenic capacity of the lipid profile in pregnant Sahel goats is high. Provided species to species extrapolation is allowed, the implication of this result is that consumption of meat from pregnant animal has high potential for atherogenic risk. Although atherogenesis is a multifactorial process, the popularity of goat meat could represent high percentage of population-attributable risk of developing cardiovascular disease. It is recommended therefore, that antemortem inspection be conducted to identify pregnant animals for restriction or advice against their slaughter. Legislation prohibiting the slaughter of pregnant animals should be enforced.

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