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PRELIMINARY STUDY ON THE ACUTE EFFECT OF CONSUMING GOAT MEAT ON BLOOD PRESSURE AND BLOOD LIPID PROFILE IN MEN AND WOMEN WITH MILD HYPERTENSION

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ABSTRACT. In Malaysia there are public opinion that goat meat contributes to high blood pressure and high blood cholesterol level that can lead to cardiovascular diseases. The

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aim of this study was to investigate this perception. 10 subjects were involved in the study, five men and five women. They were given fixed amount of goat meat soup with two slices of bread and a cup of sugarless barley drink. Paired-samples t-test was used to compare the differences in the subjects' blood pressure and cholesterol level between pre- and post- intake of goat meat. The results of this study shows that consumption of goat meat does not cause increase risk of blood pressure and cholesterol level.

Keywords: goat meat, hypertension

INTRODUCTION

Hypertension is one of the potential risk factor for cardiovascular disease (Sowers *et al.,* 2001). Ashaye *et al.* also suggested that increased consumption of red meat was associated with a higher risk of incidence of heart failure among US male physicians (Ashaye *et al.*, 2010). According to ACES, goat meat, which is a red meat, is leaner and has higher nutritional composition compared to beef and pork, and meat of lamb, sheep and chicken. The amount of saturated fat in goat meat is less than the total amount of unsaturated fat. It can improve blood cholesterol levels, eases inflammation and stabilises heart rhythms (Ashaye *et al.*, 2010 and Devendra C., 1988).

In Malaysia, public opinion is that goat meat contributes to high blood pressure and high blood cholesterol

level that can lead to cardiovascular diseases. This might result in the lack of consumer trust in goat meat which can also affect the goat meat industry. Jenie *et al.* reported that consumption of goat meat, cooked as satay, increased blood pressure in malenormotensive young adults (Jenie *et al.*, 2008). However, no published research has been found about goat meat consumption associated with acute hypertension or blood pressure and cholesterol levels in Malaysia. Therefore, perception on the risk of health in relation to goat meat should be investigated. The aim of this study was to investigate the associations between goat meat intake and risk of hypertension and high cholesterol in adults working at University Malaya Medical Centre, Kuala Lumpur (UMMC).

SUBJECTS AND METHODS

Recruitment of Subjects

Volunteers with mild hypertension were recruited from UMMC by advertisement at the university. The study was approved by the Ethical Committee of UMMC. Participation in the study followed a verbal and written explanation. Written informed consent was obtained from all volunteers prior to the screening procedures.

A medical history was taken including past illness, allergy, tobacco and alcohol consumption and current use of other medically active substances. Age, sex, weight, height, BMI and literacy were recorded. Following a physical examination, blood pressure and pulse rate, general medical examination of the subject was done. Entry to the study was gained following review of pathology reports and medical history. To be eligible for the study, subjects can be male or female 30-55 years of age, having a systolic blood pressure of 140-160 mmHg, having a BMI above 18 kg/m^2, be able to communicate effectively with study personnel and be literate and able to give consent.

The specific exclusions criteria were subjects who have a history of allergic responses to goat meat, use of more than one hypertensive medication, secondary hypertension, no history of diabetes but with fasting blood glucose concentration greater than 6.0 mmol/L, history of drug dependence, drug history of alcoholism or of moderate alcohol uses, any disease or condition which might compromise the haemopoetic, gastrointestinal, renal, hepatic, cardiovascular, respiratory, central nervous system, diabetes, psychosis or any other body system, history or presence of asthma (including aspirin induced asthma), smokers who smoke more than 10 cigarettes per day or those who cannot refrain from smoking during the study period, history of difficulty with donating blood or difficulty in accessibility of veins, positive hepatitis screen, positive test results for HIV antibody and/or syphilis (RPR/VDRL), unusual diet (e.g. low sodium) for four weeks prior to receiving the study medication and throughout the subject's participation.

Study Restrictions

Subjects were instructed to abstain from consuming caffeine and/or xanthine products (i.e. coffee, tea, chocolate, and caffeine containing sodas, colas, etc. tobacco and tobacco containing products for at least 24 hours prior to each dosing and throughout the periods when blood samples were being obtained, recreational drugs, alcohol and its products, for at least 48 hours prior to each dosing and throughout the periods when blood samples were being obtained.

Subjects were given the standardised meal according to their prepared schedule in sitting posture with a cup of sugarless barley drink at ambient temperature. Each subject was asked to finish the meal in 20 minutes.

Fatty Acid Composition

Analysis of fatty acid composition in goat meat was following procedure as described by Li *et al.* (Li *et al.*, 2001). Briefly, lipids were extracted and then derivatized so that individual fatty acids were available for analysis in a gas chromatograph (Model HP 6890, Hewlett-Packard) equipped with a flame ionization detector (GC-FID) and a non-bonded poly(biscyanoprophyl siloxane) capillary column.

Data on fatty acid composition in meats are presented in Table 1. In lipid extracts of Boer goat meat, 18 fatty acids (comprised of eight saturated, seven monounsaturated and three polyunsaturated) were identified. The predominant fatty acids found in Boer goat meat were: myristic (C14:0), palmitic (C16:0) and stearic (C18:0).

Table 1. Profile of saturated, monounsaturated and polyunsaturated fatty acid content (mean (%) ± SD) of Boer goat meat

	Fatty Acid	Mean Concentration (%)
Saturated Fatty Acid		
1	Butyric acid C4:0	1.16 + 0.38
2	Lauric acid C12:0	4.41 + 0.81
3	Myristic acid C14:0	18.35 + 2.50
4	Pentadecanoic acid C15:0	0.96 + 0.06
5	Palmitic acid C16:0	40.60 + 3.47
6	Heptadecanoic acid C17:0	1.32 + 0.10
7	Stearic acid C18:0	22.59 + 2.74
8	Arachidic acid C20:0	1.17 + 0.28
Unsaturated Fatty Acid		
1	Myristoleic acid C14:1	0.42 + 0.20
2	cis-10-Pentadecenoic acid C15:1	0.29 + 0
3	Palmitoleic acid C16:1	1.90 + 0.53
4	cis-10-Heptadecenoic acid C17:1	0.32 + 0.02
5	Elaidic acid C18:1n9t (trans)	0.27 + 0.06
6	Oleic acid C18:1n9c (cis)	8.06 + 4.65
7	Linolelaidic acid C18:2n6t	0.65 + 0.22
8	Linoleic acid C18:2n6c	0.53 + 0.14
9	Erucic acid C22:1n9	1.77 + 1.76
10	cis-4,7,10,13,16,19-Docosahexanoic acid C22:6n3	1.25 + 0.09

Diet

Two Boer goats aged one-year-old, weighing 36 and 38 kg were used in this study. The fatty acid compositions were analysed by a method reported previously (Li *et al.*, 2001) and presented in Table 1. The goats were obtained from Kg Kuala Pah, Kuala Klawang, N. Sembilan and processed at the slaughterhouse.

Standardized meal was prepared by the dietitians and chefs of UMMC kitchen. It was comprised of 130 g goat meat soup with two slices of bread and a cup of sugarless barley drink for each person. It was served to subjects for breakfast at 9:00 am. Each subject was given 20 minutes to consume the meal.

Blood Pressure Monitoring

Blood pressures were taken by a qualified medical doctor using a standard blood pressure cuff (Omron 10 series). Blood pressure measurements were taken prior to the standardized meal, following a standard protocol. Measurements were taken after the participant remained quietly seated with both feet on the floor and had rested for 10 minutes. Two measurements of systolic and diastolic blood pressure were taken.

After consuming the standardised meal, subjects were allowed to engage in normal activities, watching TV, reading, etc., but had to maintain an upright position for at least an hour. Subsequently, blood pressure was monitored at 15-minute, 30-minute, 45-minute, and 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0-hour time point (after the meal).

Blood specimen collections

One blood sample was taken after a 12-h fast before the beginning of experimental periods and after the end of the experimental periods (4-hr post-dose). Blood was drawn after the participant has rested quietly, legs uncrossed, for 5 minutes. Using a standard protocol, 15 ml blood was drawn into specimen tubes containing EDTA, and allowed to clot at room temperature. Blood samples were centrifuged immediately for 10 min at 1500×*g* at 4 °C to separate plasma. The serum was immediately poured off and refrigerated at 4 °C for transport and then sent to Pantai Premier Pathology Laboratory for analysis of triglyceride, total cholesterol, low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) contents.

Statistical Analysis

Statistical analyses were performed with SPSS. Paired-samples t-test was used to compare the differences in the subjects' blood pressure and cholesterol levels between pre- and post-intake of goat meat.

RESULTS AND DISCUSSION

It is well reported that the pathogenesis of hypercholesterolemia and hypertension takes a long time. There are other factors

Table 2. Demographic characteristics of 10 adults participating in the study

Characteristics	Men (n=5)	Women (n=5)	Total (n=10)
Age (year)	46 + 9.8	51 + 4.0	48 + 7.5
Race, n (%)			
Malays	5 (100%)	5 (100%)	10 (100%)
BMI (kg/m^2)	28.9 + 2.4	30.2 + 2.9	29.6 + 2.6
District			
Kuala Lumpur	2	1	3
Petaling	3	1	4
Klang	0	1	1
Kuala Langat	0	1	1
Hulu Langat	0	1	1

Table 3. Systolic and diastolic blood pressure for 10 subjects

	SBP (mm Hg)			DBP (mm Hg)		
Time	Before Diet	After Diet	p-value	Before Diet	After Diet	p-value
0 min Vs 1 hour	1.445 x 102	1.4502 x 102	0.792	89.3000	83.2250	0.004
0 min Vs 2 hours	1.445 x 102	1.4800 x 102	0.290	89.3000	85.4500	0.010
0 min Vs 3 hours	1.445 x 102	1.4160 x 102	0.324	89.3000	89.1000	0.005
0 min Vs 4 hours	1.445 x 102	1.5005 x 102	0.022	89.3000	85.5938	0.918
0 min Vs 2-4 hours	1.445 x 102	1.4655 x 102	0.349	89.3000	86.3833	0.024

p-value < 0.05 indicates significant difference

that can contribute to this problem such as food not prepared or consumed in a healthy manner. However, in Malaysia, goat meat has been associated with blood pressure or hypertension and increase in cholesterol. This study was conducted to investigate this perception scientifically.

The volunteers involved in this study were between 34 and 55 years of age. The body mass indexes ranged between 25.2 and 31.6 kg/m^2 for men and between 26.9 and 33.3 for women. Ethnicity of volunteers was all Malays. More than half of the participants were from Kuala Lumpur and Petaling District and the rest were from Kelang, Kuala Langat and Hulu Langat (Table 2). All subjects were those with blood pressure levels slightly above normal, having blood pressure between 140-160 mmHg.

The blood pressure levels are summarised in Table 3. The systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels were compared between before and after consumption of goat meat. Results from the current study showed that the intake of goat meat was negatively associated with increase of systolic blood

Table 4. Triglyceride, LDL, HDL and total cholesterol content for 10 subjects

	Before Diet (mmol/L)	After Diet (mmol/L	p-value
Triglyceride	1.7500	2.1300	0.174
LDL cholesterol	2.6700	2.8200	0.601
HDL cholesterol	1.3200	1.3300	0.591
Total Cholesterol	5.0200	5.1200	0.085

p-value < 0.05 indicates significant difference

pressure at 1-hour, 2-hour and 3-hour. This association was not statistically significant (p<0.05). However, SBP were found to be significantly associated with increase in blood pressure at 4-hour.

For the diastolic blood pressure, the results were not conclusive. It was found that the association was statistically significant at 1 and 3-hour but the association was non-significant at 2 and 4-hour. This was due to the great inter-individual variations in the blood pressure after meal and before meal, where only very large difference in the blood pressure can be seen in this type of study. This is most likely due to the biorhythm changes in a normal human subject. The blood pressure changes slightly throughout the day, which is higher in the morning and tapers down through the evening and night (Giles, 2005).

Study conducted by Sunagawa *et al*., in animal studies have shown that consumption of goat meat gives no effect on blood pressure. Instead the high salt content in the meat which causes an increase in blood pressure (Sunagawa *et al*., 2014).

There were no significant differences for cholesterol, LDL, HDL and triglyceride content before and after taking goat meat (Table 4).

CONCLUSION

There were no changes in the blood pressure levels of the subjects after consuming the goat meat. The slight changes that were measured were not significant. The slight variations that were observed could most likely be due to the circadian rhythm and the normal biorhythms of the different subjects.

This preliminary study also demonstrated no significant effects of goat meat consumption on total cholesterol, LDL, HDL and triglyceride content. However, the sample size was small. A larger or more definitive study may be required.

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