The Effect Of Diets Varying In Curcuma (*Curcuma xanthorrhiza* Roxb) On Blood Plasma LDL-peroxidation In Rabbits

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Introduction

Fat in food has attracted much attention, due to the concern of the people diet towards their health. Fat is believed to the cause of atherosclerosis and cardiovascular diseases (Carpenter, 1995).

In developed countries, the cardiovascular disease is the first cause of death among middle aged people (Stein, 1994). The death rate due to this disease is also increasing in developing countries, probably related to changes in lifestyle and food eaten. This ranges from traditional foods with contain carbohydrates, vegetables and fibers, to foods which are high in protein, fat, sugar and salt but lack fibre. High lipid food sources are eggs, nuts, avocado, seeds, fresh meat and fish (Food and Drug Administration, 1985).
The death rate due to this disease is also increasing in developing countries. In 1972, cardiovascular disease was the eleventh cause of death in Indonesia but then rose to a third in 1986 and became the first in 1992, causing 16 per cent of the total deaths. In 1995, this had increased to 24. 5 per cent (Sumantri 1995).

Hypercholesteromia has received attention as a risk factor for the development of coronary heart disease (Connor and Connor 1994). It is important to decrease excess levels of cholesterol to amounts consistent with the maintenance of normal body functions in order to reduce the risk of atherosclerosis development

The concentration of plasma cholesterol can be regulated via manipulation of lipid metabolism, the absorption of dietary cholesterol and the excretion of lipid through faeces. Researchers have developed effective plasma cholesterol-lowering agents with some of the drugs commonly used being lovastatin, pravastatin and simvastatin (Lee *et al* 1999).
Pharmaceutical drugs are seen increasingly as being over-prescribed, expensive and even dangerous (Snider 1991). Herbal remedies are less expensive and less toxic and many people especially those with chronic illnesses such as high cholesterol, atherosclerosis, rheumatism, tumours and hepatitis are turning to herbs as adjuncts to other treatments.

In Indonesia, women have long used curcuma to guard against becoming fat. It is believed that curcuma has properties that are antilipid deposition (Subba *et al* 1972). However, this is based on empirical evidence and there is a dearth of information on how it works. Curcuma is used more as a spice than a drug, but some people use this mixture of herbs as medicine. Curcuma has been found to have anti-inflammatory, anti-infectious and anti-tumour properties (Allen *et al* 1998).

This study was set up to evaluate the effect of inclusion of curcuma in rabbit diets on lipid metabolism.as well as LDL-peroxidation. Rabbits were chosen as a model monogastric animal.

MATERIALS AND METHODS

Animals and Housing

Forty growing male New Zealand white rabbits of average body weight 2.3±0.216 kg were used. The animals were obtained from the research institute for animal production, Bogor, Indonesia and were individually housed in metabolic wooden cages in a room to adapt to laboratory conditions.

Diets

Four isoenergetic and isoatherogenic diets with different levels of curcuma were prepared. The diets contained 0, 0.2, 0.3 and 0.4 per cent curcuma, respectively, representing atherogenic (A), atherogenic low curcuma (ALC), atherogenic medium curcuma (AMC) and atherogenic high curcuma (AHC), respectively.

Experimental Procedure

Experimental design

A completely randomised block design (CRBD) was used in this experiment. Blocking factor was initial cholesterol concentration. The rabbits were randomly distributed within blocks into four experimental groups of ten animals per treatment, giving ten replications per treatment.

Animal Management and Data Collection

The rabbits were offered the respective diets for fourteen days to allow for adaptation before faeces and feed samples were collected for seven days. The samples were stored in a freezer (-25°C) prior to analysis of the proximate constituents.

The animals continued on their respective diets for a total period of four months. Feeding was *ad libitum* throughout the period allowing for 20 per cent more of the previous day's intake. Fresh feed and water were provided daily. The refusals were collected and weighed for each animal throughout the collection period.

Body weight was measured weekly. Blood samples were taken at the beginning of the study and at 4, 9 and 17 weeks in the study. Animals were fasted overnight and were bled from the vena jugularis of the ear. Blood was collected into heparinised tubes. Plasma was separated by centrifugation at 10 000 g in a refrigerated centrifuge (4°C) for 20 minutes.

Lipid Peroxidation

Lipid peroxidation was measured using the isoprostane immunoassay kit following the ELISA method (Marrow 1995).

Statistical Analysis

The randomised complete block design model was used for data analysis:

$Yijk = \mu + Ti + Bj + eijk,$

Where Yijk = measured response variable; μ = overall mean; Ti = treatment effect; Bj = blocking effect and eijk = random error. Significance of differences of treatment means were tested using the Duncan's Multiple Range Test (Duncan, 1955).

Results

Dietary curcuma decreased plasma LDL-peroxidation in rabbits fed diets with curcuma inclusion. The depression overally was 19.77, 65.06 and 66.43 per cent on 0.2, 0.3 and 0.4 per cent curcuma level, respectively.

Discussion

Currently, cardiovascular disease prevention is gaining worldwide momentum. This has led to many studies being conducted to evaluate the use of certain short-term tests to gain information on disease preventive agents. Many of the substances are present in a natural environment of man including diet. These dietary inhibitors of cardiovascular disease mainly of plant origin are being evaluated for their anti-cardiovascular disease properties. Most of these are either anti-hypercholesterolemia or act by stimulating the activity of enzymes, which reduce cholesterol content in the host.

The concentration of plasma cholesterol in the body can be regulated via biosynthesis of cholesterol, the removal of cholesterol from the circulation, the absorption of dietary cholesterol or the excretion of cholesterol via bile and faeces.

Curcuma has several active compounds, the most studied of which is curcumin. Curcumin can have anti-oxidant activities due to its hydroxyl groups, anti-inflammatory activities due to its keto groups and anti-mutagen and anti-cancer activities due to its double bonds. The use of curcuma in rabbit diets was evaluated on its effects on lipid metabolism in this study.

Curcumin content was not measured in this study. However, from literature, each 100 g of *curcuma xanthorrhiza* yielded approximately 5 g curcuminoids (*curcumin desmethoxycurcumin*) (Yasni *et al* 1993). Assuming that the curcuma used in this study contains 5 per cent curcuminoids, this translates to 4.98, 6.69 and 10.12 mg d^{-1} curcumin intake on 0.2, 0.3 and 0.4 per cent curcuma inclusion diets.

The oxidative modification of LDL within the arterial wall is implicated in the early stages of atherogenesis. Oxidised LDL assists in foam cell formation, is cytotoxic and instigates various proatherogenic processes (Berliner and Heinecke 1996). Increasing antioxidant defence against such damage may therefore attenuate the initial stages of atherogenesis. It has been reported that demethylated derivatives of curcumin are the most potent inhibitors of lipid peroxidation and complete methylation of these compounds leads to abolition of antioxidant activity (Ruby *et al* 1994). Curcumin in solution has been shown to act as a photosensitiser of oxygen radicals and also curcuminoids at a concentration of 0.0133 mg ml^{-1} have been found to inhibit the peroxidation of linoleic acid (Tonnesen 1988). Lipid peroxidation induced by atherogenic diets was completely prevented by 0.3 and 0.4 per cent of curcuma in rabbit diets in this study. This inhibition of lipid peroxidation is most likely caused by the fact that curcumin may act as a strong antioxidant due to its two phenolic groups. Methylation of these phenolic groups has been demonstrated to depress this activity significantly (Sharma 1976).

CONCLUSIONS

Results from this study suggest that curcuma has a role in minimising the incidence of coronary heart disease. This medicinal plant is readily available in Indonesia and there is scope in conducting similar work with human beings where these observed effects of curcuma might find ready application. Curcuma, as a medicinal plant or as a herbal remedy is less expensive and less toxic. It can be recommended as a phytotherapeutic agent.

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Table 1. Plasma LDL-peroxidation concentration at 4 months treatment in rabbits fed diets with different levels of curcuma

Treatments	N	LDL-peroxidation
		4 months
Atherogenic	10	4.683[a]
Atherogenic + Low Curcuma	10	3.757[ab]
Atherogenic + Medium Curcuma	10	1.636[b]
Atherogenic + High Curcuma	10	1.572[b]

N = amount, Mean in same column without a common superscript difference significantly (P<0.05)

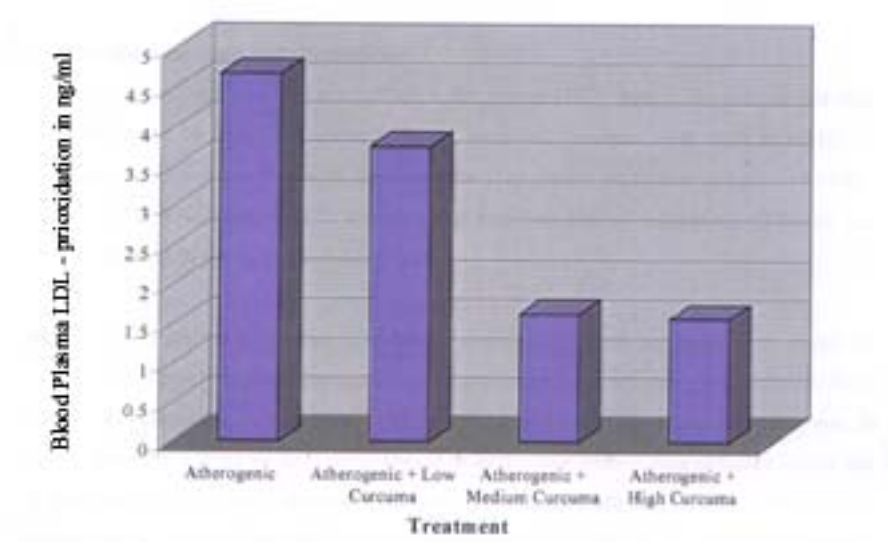

Figure 1 The effect of diets varying in curcuma on blood plasma LDL-perixiodation in rabbits after four months.