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Full Length Research Paper

Anti-atherogenic effects of supplementation with vitamin B6 (Pyridoxine) in albino rats

Adekunle Adeniran S. and Adedeji Adebayo L.

Department of Biochemistry, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

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Elevation of serum lipids have been implicated to predispose to cardiovascular disorders which includes hypertension, stroke, atherosclerosis etc. Various studies have reported links between supplementation with vitamin B complex and reduction in oxidative stress and inflammatory reactions, two events associated with cardiovascular disorders. Data on possible direct regulation on lipid profile by vitamin B6 is very scanty. This study is therefore designed to assess role of administration of vitamin B6 in regulation of serum lipids such as total cholesterol, phospholipids, triglycerides, and high density lipoprotein cholesterol (HDL-C). Results showed that serum total cholesterol and triglyceride were significantly reduced ($p \leq 0.05$) in rats placed on vitamin B_6 supplements compared with control group. Serum phospholipids and high density lipoprotein cholesterol were significantly elevated ($p \leq 0.05$) in rats placed on vitamin B_6 supplements when compared with control group. The data showed anti-hyperlipideamic effects of vitamin B6 supplementation in rats.

Key words: Pyridoxine, lipids, cardiovascular disorder, supplement.

INTRODUCTION

Cardiovascular diseases (CVD) are caused by disorder of the heart and blood vessels and include the coronary heart disease, raised blood pressure that is, hypertension etc. Major traditional risk factors of CVD include elevated serum levels of total cholesterol, triglyceride, low density lipoprotein and reduced serum concentration of high density lipoprotein among other things. The disease is the most common cause of sudden death (Thomas et al., 1988) and is also the most common reason for death of men and women over 20 years of age (American Heart Association, 2007). According to present trends in the United States, half of healthy 40-year-old males will develop coronary artery disease (CAD) in the future, and one in three healthy 40-year-old women (Rosamond et al., 2007). Traditionally, these conditions are considered to result from lipid abnormalities, and other risk factors such as hypertension, smoking, hyperhomocysteinemia and diabetes (Niessen et al., 2003).

The conditions have caused lots of losses in both human and material resources. Among recommended antidote to this include adjustment in lifestyle which involves nutritional modifications, slight physical exercise and in some instances use of drugs (Djousse et al., 2009).

A connection between homocysteine (a sulphur containing amino acid) and cardiovascular disease was proposed when it was observed that people with a rare hereditary condition called homocysteinuria are prone to develop severe cardiovascular disease in their teens and twenties and this was comfirmed by the study of David et al. (2002). In this condition an enzyme deficiency causes homocystiene to accumulate in the blood and to be excreted in the urine. Elevations in plasma homocystiene level promote oxidative damage, inflammation and endothelial dysfunction and are independent risk factor for cardiovascular disease.

Furthermore, epidemiological studies have shown plasma homocysteine levels are inversely related to plasma levels of folate, B12 and B6- the three vitamins involved in the conversion of homocystiene to methionine and cysteine.

This study is designed to assess possible lipid-lowering effect of administration of vitamin B6 and also the protective effect of the administration towards development of cardiovascular disease.

*Corresponding author. E-mail: kunleniran@yahoo.com. Tel: +234 (0) 8060967829.

Table 1. Effect of vitamin B_6 supplement on total cholesterol, triglyceride, phospholipid and HDL-cholesterol.

Biochemical parameters	Control group	Vitamin B6 group
Total cholesterol	130.96 ± 19.84	109.62 ± 19.64*
Triglyceride	160.32 ± 50.15	104.93 ± 13.04*
Phospholipids	103.33 ± 28.45	137.04 ± 47.12*
HDL-cholesterol	124.03 ± 62.79	150.60 ± 84.05*

Significant at *p<0.05 when compared with control values.

EXPERIMENTAL DESIGN

Experimental animals

Sixteen 14-week old albino rats with an average weight of 136 g were purchased from commercial breeder in Ilorin, Kwara State. They were kept in a well-ventilated cage in the animal house of the Department of Anatomy, Ladoke Akintola University of Technology, Nigeria. The animals have unrestricted access to clean water and were fed commercial normal feed as described by Kong et al. (2009).

They were separated into 2 groups, each group consisting of eight rats. Group one were not given vitamin B supplement (control) while group two were given a therapeutic dose of 0.2 mg/kg body weight of vitamin B6 for 28 days. All animal procedures were in strict accordance with the NIH Guide for the Care and Use of Laboratory Animals.

Sample collection

On the 28th day, the rats were sacrificed and blood samples were obtained through cardiac puncture (Yin et al., 2008). The blood was collected into appropriately labeled sample bottles and centrifuged at 4000 rev/s for 5 min (Kong et al., 2008; Deng et al., 2009). The supernatants were decanted and stored at -2°C for analyses of biochemical parameters (Wu et al., 2010).

Determination of biochemical parameters

The biochemical parameters determined included total cholesterol, triglyceride, high density lipoprotein, and phospholipid.

Determination of total cholesterol

Total cholesterol was determined using enzymatic method described by Allain et al. (1974). Cholesterol esterase hydrolyses cholesterol esters to free cholesterol. The free cholesterol produced is oxidized by cholesterol oxidase to cholesten-4-ene-3-one with simultaneous production of hydrogen peroxide which couples with 4-aminoantipyrine and phenol in the presence of peroxidase to yield chromogen with maximum absorption at wavelength 510 nm, The colour intensity is proportional to the cholesterol concentration.

Determination of triglycerides

Triglyceride was determined using enzymatic method described by Buccolo and David (1973). Triglycerides are hydrolyzed by lipases to yield glycerol and fatty acids. The glycerol produced is oxidized to dihydroxylacetone phosphate with the production of hydrogen peroxide which couples with 4-aminophenazone and 4-chlorophenol to produce a chromogen referred to as quinoneimine. The reaction is catalyzed by peroxidase. The degree of absorbance of the chromogen is directly proportional to the concentration of triglyceride measured at 505 nm.

Determination of high density lipoprotein

The precipitation method by Assmann et al. (1983) was used to determine HDL-cholesterol. The addition of phosphotungistic acid in the presence of magnesium ions precipitates quantitatively low density lipoprotein, very low density lipoprotein and chylomicron fractions from whole plasma, leaving the HDL fraction in the supernate. The cholesterol in the HDL which remains in the supernatant after centrifugation is estimated using the enzymatic method of Allain et al. (1974).

Statistical analysis

Quantitative data were presented as mean ± SD. Triglyceride, total cholesterol, phospholipids and high density lipoprotein between the two groups were compared using student's 't' test. A value of $p<0.05$ was considered statistically significant.

RESULT

Table 1 shows the mean plasma concentrations of selected biochemical parameters (total cholesterol, triglyceride, phospholipids, HDL-cholesterol) in different experimental groups that is, control and group given vitamin B6.

The mean concentrations of total cholesterol and triglyceride were significantly decreased in group given vitamin B6 as compared with the values in the control group, while there were increases in the mean concentrations of phospholipids and HDL-cholesterol when compared with the values obtained in the control group.

DISCUSSION

Cholesterol plays a major role in human heart health and high cholesterol is a leading risk factor for the development of human cardiovascular disease. It was observed that there was a significant decrease in the level of cholesterol in animals that were administered with vitamin B6 as compared to control animals. High plasma cholesterol has been linked with hyperlipidemia which is associated with increased risk of cardiovascular disease (Naito, 1984). Studies have proved that low cholesterol is a desirable level in the body for normal and proper function (Zuhani et al., 2010).

Triglyceride is a fat in the blood stream and high levels of triglycerides has been linked to atherosclerosis' (hardening of arteries) and by implication the risk of heart disease and stroke. It was observed that there was a significant decrease in the level of triglycerides in animals that were administered with vitamin B6 as compared with control animals. Studies have shown that low concentration of triglyceride is normal for the body (Zuhani et al., 2010). High triglyceride level does indicate a defect in the system and recent evidence strongly suggests that high serum concentration is significantly associated with cardiovascular disease (Altan et al., 2006).

High density lipoprotein-cholesterol (HDL-C) is referred to as the good cholesterol because of its relevance to the cardiovascular system. HDL-C helps to remove extra cholesterol from the body. Study had shown that when HDL-C is higher, there is lower chance of heart disease and that higher level of HDL-C predicts longevity (Zuliani et al., 2010). It was observed that there was a significant increase in the levels of HDL-C in animals that were placed on vitamin B6 compared to control animals. The observation is consistent with the findings of Balch (2006), who observed significantly elevated serum HDL-cholesterol in vitamin B6 administered rats.

Phospholipids are compound lipids that participate in the lipoprotein complexes which are thought to constitute the matrix of cell walls and membranes, the myelin sheath, and of such structure as mitochondria. It was observed that there was a significant increase in the level of phospholipids in animals that were administered with vitamin B6 compared to control animals. For the future study, the factional amino acids, such as argnine also should be considered to be used by combined with B_6. Recently, leading findings told us that arginine can enhance blood flow, antioxidant activity, protein synthesis, immune cell proliferation, and intestinal development, thereby improve animal health (Tan et al., 2009; Yin and Tan, 2010; Yao et al., 2008, 2011; Geng et al., 2011).

From this study, it was observed that the supplementation with vitamin B6 resulted in an increased serum concentration of HDL-cholesterol and phospholipids and a reduction in the serum level of total cholesterol and triglyceride. High levels of HDL-cholesterol and low levels of total cholesterol and triglyceride are indications of a good cardiovascular health. It may be suggested that administration of vitamin B6 can be encouraged as this may help in reducing the rate of accumulation of total cholesterol and triglyceride, which is the two major factors of atherogenicity.

REFERENCES

Allain CC, Poon LS, Chan CSG (1974). Enzymatic determination of total serum cholesterol. Clin. Chem., 20: 470-475.

Altan O, İbrahim S, Mehmet Y, Günay C, Gülay H, Günsel ŞA (2006). Plasma triglycerides, an independent predictor of cardiovascular disease in men: A prospective study based on a population with prevalent metabolic syndrome. Int. J. Cardiol., 19(1): 89-95.

American Heart Association (2007). Heart Disease and Stroke Statistics-2007 Update. AHA, Dallas, Texas.

Assmann G, Schriewer H, Schmitz G, Hagele EO (1983). Quantification of HDL-C by precipitation with phosphotungstic acid and $MgCl_2$. Clin. Chem., 29(12): 2026-2030.

Balch PA (2006). Prescription for nutritional healing. 4th ed. New York: Avery, p. 54.

Buccolo G, David H (1973). Quantitative determination of serum triglyceride by the use of enzymes. Clin. Chem., 19: 476-482.

David SW, Malcolm L, Joan KM (2002). Homocysteine and cardiovascular disease: evidence on causality from a meta-analysis. BMJ, 325(7374): 1202.

Djousse L, Driver JA, Gazioano JM (2009). Relation between modifiable lifestyle factors and lifetime risk of heart failure. JAMA, 302: 394-400

Geng MM , Li TJ, Kong XF, Song XY, Chu WY, Huang RL, Yin YL , Wu GY (2011). Reduced expression of intestinal N-acetylglutamate synthase in suckling piglets: a novel molecular mechanism for arginine as a nutritionally essential amino acid for neonates. Amino Acids, 40: 1513-1522.

Kong X.F, Yin YL, He QH, Yin FG, Liu HJ, Li TJ, Huang RL, Geng MM, Ruan Z, Deng ZY, Xie MY. Wu G (2008). Dietary supplementation with Chinese herbal powder enhances ileal digestibilities and serum concentrations of amino acids in young pigs. Amino Acids, 37: 573-582.

Kong XF, Zhang YZ, Yin YL, Wu GY, Zhou HJ, Tan ZL, Yang F, Bo MJ, Huang RL, Li TJ, Geng MM (2009). Chinese Yam polysaccharide enhances growth performance and cellular immune response in weanling rats. J. Sci. Food Agric., 89(12): 2039-2044.

Naito K (1984). Lipids. Clin. Chem., The C.V; 918-919 and 570.

Niessen HW, Krijnen PA, Visser CA, Meijer CJ, Erik HC (2003). Type II secretory phospholipase A2 in cardiovascular disease: a mediator in atherosclerosis and ischemic damage to cardiomyocytes? Cardiovasc. Res., 60(1): 68-77.

Rosamond W, Flegal K, Friday G (2007). "Heart disease and stroke statistics--2007 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee". Circulation, 115(5): 169-171.

Tan B, Yin YL, Liu ZQ, Li XG, Xu HJ, Kong XF, Huang RL, Tang WJ, Shinzato I, Smith SB, Wu GY (2009). Dietary L-arginine supplementation increases muscle gain and reduces body fat mass in growing-finishing pigs. Amino Acids, 37: 169-175.

Tan BE, Li XG, Kong XF, Huang RL, Ruan Z, Deng ZY, Xie MY, Shinzato I, Yin YL, Wu G (2009). Dietary L-arginine supplementation enhances the immune status in early-weaned piglets. Amino Acids, 37: 323-331.

Thomas AC, Knapman PA, Krikler DM, Davies MJ (1988). "Community study of the causes of “natural” sudden death. BMJ, 297(6661): 1453-1456.

Wu X, Yin YL, Li TJ, Wang L, Ruan Z, Liu ZQ, Hou YQ (2010). Dietary supplementation with l-arginine or N-carbamylglutamate enhances intestinal growth and heat shock protein-70 expression in weanling pigs fed a corn- and soybean meal-based diet. Amino Acids, 39: 831-839.

Yao K, Guan S, Li TJ, Huang RL, Wu GY, Ruan Z, Yin YL (2011). Dietary L-arginine supplementation enhances intestinal development and expression of vascular endothelial growth factor in weanling piglets. Br. J. Nutr., 105: 703-709.

Yao K, Yin YL, Chu WY, Liu ZQ, Dun D, Li TJ, Huang RL, Zhang JS, Tan B, Wang WC, Wu GY (2008). Dietary Arginine Supplementation

Increases mTOR Signaling Activity in Skeletal Muscle of Neonatal Pigs. J. Nutr., 138: 867-872.

Yin YL, Tan BE (2010). Manipulation of dietary nitrogen, amino acids and phosphorus to reduce environmental impact of swine production and enhance animal health. J. Food Agric. Environ., 8: 447-462.

Yin YL, Tang ZR, Sun ZH, Liu ZQ, Li TJ, Huang RL, Ruan Z, Deng ZY, Gao B, Chen LX, Wu GY, Kim SW (2008). Effect of galacto-mannan-oligosaccharides or chitosan supplementation on cytoimmunity and humoral immunity response in early-weaned piglets. Asian-Aust. J. Anim. Sci., 21:723-731.

Zuhani G, Cavalieri M, Galvani M, Volpato S, Cherubim A, Bandinelli S, Corsi M, Lauretain I, Guranik J, Fellin R, Ferrucci L (2010). Relationship between low levels of high density impoprotein cholesterol and dementis in the elderly. The inchianti study. J. Garentol. Sries A, 65A: 559-564.