Effect *of Morinda citrifolia* (Noni) fruit powder in the lipid profile of Sprague-Dawley rats

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ABSTRACT

Morinda citrifolia, known commercially as noni, has been extensively distributed mostly in the Pacific and is one of the most significant sources of traditional medicines among Pacific island societies. All parts of the plant have traditional and modern uses, including roots and bark which can be used as dyes and medicines, trunk for firewood and tools, and leaves and fruits for food and medicines. It has proven many essential activities out of the properties that it possesses which has been reported to have a broad range of therapeutic effects as well as functioning as a painkiller. *Morinda citrifolia* has metabolites that help in the breakdown of lipids (or fats) for the generation of metabolic energy. This study determined the effects of noni fruit powder in the lipid profile cholesterol, high density lipoprotein (HDL), triglyceride (TAG), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) of dyslipemic Sprague-Dawley rats.

Sprague-Dawley rats with an initial weight of 276.8 ± 2.42 g were grouped as to positive group (treated with lipid lowering supplements), test group (treated with noni fruit powder) and negative group (normal diet). Dyslipemic Sprague-Dawley rats were studied within 5 weeks, measuring its serum lipid level one week after high fat diet and its lipid concentrations 2 weeks and 4 weeks after the administration of 100 mg noni fruit powder and Atorvastatin as control subsequent to high fat diet.

The administration of 100 mg of noni fruit powder for 4 week duration lowered the lipid profile of the laboratory animals in terms of cholesterol, triglycerides, HDL and VLDL with a mean difference of ±32.93.Furthermore, the effect of 100 mg noni fruit powder has no significant difference on the effect of 10 mg Atorvastatin with a p value of < 0.05.

The lipid lowering effect of 100 mg of noni fruit powder in terms of cholesterol, HDL, TAG and VLDL is similar to the effect of 10 mg Atorvastatin. However, it has noted that noni fruit powder and Atorvastatin has no effect in the LDL after a 4 week experimental period.

Keywords: *Morinda citrifolia*, dyslipidemia, lipid profile, noni

INTRODUCTION

Morinda citrifolia (noni) is accepted around theglobe as a tree in the coffee family, Rubiaceae(Potterat and Hamburger, 2007). It is native to, Southeast Asia and Australia, and is cultivated in Polynesia(Palu et al., 2008), India, Caribbean(MKoy et al., 2002), Central and Northern South America. It grows in shady forests as well as on open rocky or sandy shores.

Noni has been used in folk medicine to treat various kinds of symptoms and diseases. This plant is in high demand in alternative medicine for different kinds of illnesses such as arthritis, diabetes, high blood pressure, muscle ache and pain, menstrual difficulties, headaches, AIDS, gastric ulcer and asthma (Anwar et al., 2007). The fruit is valued for its use as a healthy food due to its potential immune system supporting properties (West et al., 2008) and it is not hepatotoxic (West et al., 2006). The whole plant, which includes the fruits, leaves, barks, and roots, contain various biologically active compounds that is medically important for humans (Shotipruk et al., 2004).They include anti-inflammatory (Zin et al.,2006), anti-histamine (Wang et al.), antibacterial(Shotipruk et al., 2004),antifungal (Gerson et al., 2007), antiviral(Shotipruk et al., 2004), anti-oxidant activity (Zin et al.,2006; Mohd et al., 2001), anti-cancer activity(Wang et al., 2009) , anti-tumor activity (Hirazumi, 1999) and analgesic activity (Wang, 2002). Recently, it has been found that noni is highly effective in inhibiting angiogenesis in human breast tumors(Pu et al., 2004).

Noni contains over 150 nutraceuticals, which includes Xeronine, Scopoletin, Proxeronine, Morindadiol, Proxeronase, Rubiadin, Serotonin, Magnesium, Damnacanthal, Carbonate Nordamnacanthal, Protein, Antraquinones, Sodium, Carotenoids, Bioflavinoids, Morindine, Morindone, Terpenes, Plant Sterols, Iron, Sitosterol, Phosphate, Glycosides, Carbohydrates, Aleizarin, Acetin, GlucoP, Ursolic acid, Caproic acid, Caprlyic, Glucopyranose, Asperuloside, Precursors, Vitamins, Trace elements, Alkaloids, Enzymes, Serine, Multi-receptor activators, Chlororubin, Methionine, Alanine, Isolucine, Arginine, Leucine, Aspartate, Lysine, Cysteine, Phenlyalanine, Cystine, Threonine, Glycine, Trypophane Glutamate, Valine, Tyrosine, Histadine, and Proline (Logsdon, 2008). It is proven that the pulp of noni fruit juice contains fiber which is 10-40% by weight (Palu et al., 2007). Typical bioactive chemicals can include, but are not limited to, caffeine, ephedrine, L-carnitine, creatine and lycopene (Jensen et al., 2004).

Lipids are transported in the plasma to various body tissues by lipoproteins. Lipoproteins are particles with triglycerides and cholesterol esters in their core and phospholipids and free cholesterol near the surface. Lipoproteins also contain one or more specific proteins, apoproteins, located on the surface of the particle. The major lipoprotein classes include chylomicron, very-low density lipoproteins (VLDL), low-density lipoproteins (LDL), and high density lipoprotein (HDL) (Bishop et al., 2005). High-density lipoprotein is one of the major groups of

lipoproteins which unable lipids like cholesterol and triglycerides to be transported within the water based blood. HDL can remove atheroma within arteries and transport in back to the liver for excretion or reutilization which is the main reason why HDL-bound cholesterol is sometimes called “good cholesterol”. Cholesterol contained in HDL particles is considered beneficial for the cardiovascular health, in contrast to “bad” LDL cholesterol (Cusabio, 2010).

This study determined the effects of noni fruit powder in the lipid profile (cholesterol, TAG, HDL, LDL and VLDL) of dyslipemicSprague-Dawley rats.

MATERIALS AND METHODS

Preparation of Noni Extract

Noni fruit were obtained in Burol, Sta. Teresita, Batangas. Vouchers of the plant species was submitted to the Herbarium of University of Santo Tomas for authentication with authentication number USTH-5548. The samples were washed with running tap water before being chopped into pieces. They were then oven dried at 45°C for 2 days and ground to powder (Zin et al., 2006).

Laboratory Animals

Eleven (11) Sprague-Dawley rats weighing 276.8 ± 2.42 g were obtained from Bio Philippines, Manila. They were maintained in individual wire cages at a temperature of 20-25° and a light cycle of 12 hours. (Pu et al., 2004).

Dyslipidemia was induced in all rats through feeding of 100 mg egg yolk per day for 7 days before the beginning of the experiment (Archer, 2003) and during the experiment for 7 days (Metwally et al., 2009).

Three groups of rats were used for the study, four (4) for the test and the positive control group and three (3) for the negative control. The animals of Group I served as the control (negative) and received egg yolk and 0.9% NSS at a dose of 1 ml/kg/day through oral gavage for 7 days. Group II served as the control (positive) and received egg yolk, water and Atorvastatin at a dose of 1 ml/kg/day through oral gavage. Group III received egg yolk, water and noni fruit powder at a dose of 1ml/kg/day through oral gavage.

Every two weeks, blood was obtained from the rat’s tail to monitor the LDL, VLDL, HDL, cholesterol and TAG(Keren et al., 2000). All procedures that required the use of laboratory animals secured the approval of the Bureau of Animal Industry (BAI).

Blood collection

The rats were placed in a restraining tube. Through the use of a sterile scalpel, a portion of the tail was quickly cut up to 1 cm. The blood was then collected in a microtainer tube as drops appear. Pressure was applied to stop the bleeding after collection (Hoff, 2000).

The blood was allowed to clot at room temperature for one hour, and then the serum was separated by centrifugation at 3500 rpm for 5 minutes, clear serum was stored at 20^{o}C until analyzed. (Abdel Ati, 2009).

Analytical procedures

Analysis of serum lipid levels was done through semi-automated spectrophotometer (Statfax, Awareness Technology, USA).The cholesterol was determined by an enzymatic method. Chylomicrons, VLDL and LDL of serum are precipitated by phospotungstic acid and magnesium ions. After centrifugation, HDL is in the supernatant. Cholesterol included in this phase, is measured by an enzymatic method. The TAG is determined after enzymatic hydrolysis with lipases. The indicator is a quinoneimine formed from hydrogen peroxide, 4-aminophenazone and 4-chlorophenol under the catalytic influence of peroxidase (Elitech, France).The concentration of VLDL will be estimated according to Fridewald equation (Mcpherson, 2001; Henry, 1999):

VLDL = triglycerides/5 (if > 400)
= triglycerides x 0.16 (if < 400)

According to Fridewald equation, low density lipoprotein cholesterol can be calculated as follows (Mcpherson, 2001; Henry, 1999):

LDL= Total cholesterol - HDL – VLDL

Statistical analysis

The statistical analysis was carried out using ANOVA followed by Dunnet's multiple comparison test expressed as means ± SE and statistical analyses were performed using ONEWAY ANOVA using SPSS statistical software package (SPSS for Windows, 10.0). p values less than 0.05 were considered significant (Manjunatha and Srinivasan, 2007).

RESULTS AND DISCUSSION

The aim of the current study is to determine the effects of noni juice in the lipid profile (cholesterol, TAG, HDL, LDL and VLDL) of

dyslipedimic Sprague-Dawley rats. The experiment has duration of five weeks and the blood samples were collected pre-treatment and at the end of the experimental period for the determination of serum total cholesterol, TAG, HDL, LDL and VLDL.

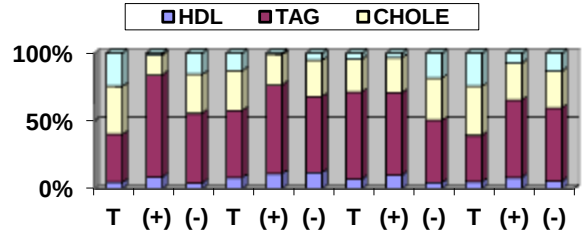

Figure 1. Average serum lipid levels

After a 4-week testing period, the average HDL values of the three groups (test, positive and negative) lowered as follows: 51.27 to -67.73, 39.1 to -66.23 and 84.57 to -50.1. The average TAG values of the test group, positive group and negative group was reduced to 281.42 to -411.54, 94.47 to -373.53 and 244.04 to 43.3 respectively. The average cholesterol values of the three mentioned group also decreased from 91.14 to -218.04, 95.15 to -112.7 and 96.2 to 34.76. Its VLDL average values also lowered from 46.58 to -68.22, 9.19 to -56.998 and 39 to 2.42. Along with this, the LDL average values increased from -7.04 to -81.9 for the test group, -1.18 to 10.4 in the positive group and -27.36 to 82.45 in the negative group.

The results demonstrated that the computed f-values were all found to be not significant at 0.05 level of significance. This indicates that there is no significant difference on the cholesterol, TAG, HDL, LDL and VLDL on the determination of the baseline levels and dyslipidemia.

Analysis of results showed that there is a significant difference on the LDL level of treated rats of positive, negative and test groups within the two succeeding weeks after the treatment as indicated by the f-value of 6.453 at 0.05 level of significance. Based on the multiple comparisons of means the LDL of rats differ significantly between test and negative groups but do not differ between positive and test groups at 0.05 level of significance. However the cholesterol, HDL, TAG and VLDL of treated mice do not differ significantly among positive, test and negative groups. Therefore, 100mg of noni and 10 mg of Atorvastatin has no significant effect on the serum lipid level in terms of cholesterol, TAG, HDL, and VLDL in a two-week duration period. It was noted however that the LDL levels for all groups increased in the first week of testing.

Based on the results gathered on the fourth week, there is a significant difference on the cholesterol, HDL, TAG and VLDL of treated rats at 0.05 level of significance. Using the results of multiple

comparisons of the means, it was noted that the cholesterol, HDL, TAG and VLDL of treated rats differ significantly between test and negative groups but do not differ significantly between test and positive groups. However the LDL of treated rats does not differ significantly at 0.05 level of significance. This indicates that there is significant effect on both 100 mg noni fruit powder and 10 mg of Atorvastatin in lowering the serum lipid level in terms of cholesterol, TAG, HDL, VLDL while LDL is not affected by all experimental groups.

Results of this study affirms the claims of noni as a potent herbal drug (Anwar et al., 2007). The lowering effect of the noni fruit powder on selected serum lipid analytes may be explained by the various nutraceutical components of noni (Logsdon, 2008). Furthermore, noni is also known to contain fiber which is 10-40% by weight (Palu et al., 2007) which may have also exerted an effect on the tested serum analytes. Also, bioactive components of the fruit as cited by Jensen et al. (2004) such as L-carnitine may have also caused the favorable decline in the selected lipid values. Since the study utilized the fruit in powder form which contains all of the above stated bioactive components, it is not possible to identify the exact bioactive component that produced the observed effects stated in the study. Further studies utilizing specific components of the noni fruit is needed to identify these bioactive components that exerts lipid-lowering effects.

CONCLUSIONS

The result of the study indicates that noni fruit powder has a potential in lowering the serum lipid in terms of cholesterol, TAG, HDL and VLDL. Furthermore, the effect of 100 mg of noni fruit powder is similar to the effect of 10 mg of Atorvastatin suggesting the potential of noni fruit powder as a substitute of the said drug. However, it has noted that noni fruit powder and Atorvastatin has no effect in the LDL after a 4-week experimental period.

RECOMMENDATIONS

The exact metabolite of noni fruit powder that exerted a lipid lowering effect was not included in the study. Therefore, further studies on such primary and secondary metabolic components of noni juice powder are suggested by the researchers. An extended duration of experimental testing is likewise recommended.

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