



Effects Of Coconut Neera (*Cocos nucifera L.*) On Blood Pressure Among Hypertensive Adult Women

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ABSTRACT

The present study evaluated the antihypertensive effects of Coconut Neera (CN) among selected hypertensive adult women of age 30-60 years in Alappuzha. Coconut Neera is sweet, oyster white and translucent natural non- alcoholic beverage collected from tapped unopened spade of coconut palm of West Coast Tall variety. Adult women with blood pressure in the range 140-159mm Hg or stage I hypertension were selected for the study according to the classification of blood pressure by Joint National Committee- 8 after getting prior consent. The experimental design was Control group (Group 1), Control +CN(Group 2), Hypertensive group (Group 3) and Hypertensive + CN group(Group 4). Group 2 and 4 received 100 ml fresh CN for 5 subsequent weeks in the morning. Systolic blood pressure (SBP) was measured every day using blood pressure monitor before and after the supplementation and the average of the readings was taken. The composition of the coconut neera namely sugar, protein, sodium, potassium, calcium, magnesium, vitamin C and phenolic content was analyzed. The supplementation of CN significantly ($P < 0.05$) reduced systolic blood pressure among hypertensives (148 ± 2 to 124 ± 4 mmHg). The diastolic pressure was significantly decreased from 96 ± 3 mmHg to 81 ± 2 mmHg and serum total cholesterol from 274.5 ± 9.7 to 209.8 ± 7.6 mg/dl. This may be due to the presence of biologically active constituents in CN possessing hypocholesterolaemic and antioxidant properties thereby reducing the blood pressure.

Key Words: Coconut Neera, Composition, Blood Pressure, serum total cholesterol, Women, Alappuzha

I. Introduction

Hypertension is an important public health challenge worldwide because of its high prevalence and concomitant increase in risk of disease. Hypertension is currently a devastating medical, social and economic problem affecting more than one billion people throughout the world [1]. It is an important risk factor for developing other cardiovascular diseases, stroke, renal failure, cerebrovascular accidents, and many other medical complications [2]. The comparative Risk Assessment Collaborating Group has identified hypertension as the leading global risk factor for mortality and as the third leading risk factor for disease burden [3].

Hypertension is defined as having a systolic blood pressure (SBP) of ≥ 140 mmHg and a diastolic blood pressure (DBP) of ≥ 90 mmHg ($\geq 140/\geq 90$ mmHg; [4]. Every 20/10 (SBP/DBP) mmHg increase indicates a higher risk stage of hypertension; stage 1 (140–159/90–99 mmHg), stage 2 ($\geq 160/\geq 100$ mmHg) with the latter stage requiring immediate medical attention [5].

Hypertension is often called the "silent killer" because it is frequently asymptomatic until it becomes severe and target organ disease has occurred. In addition to being a major player in the onset of diseases such as atherosclerosis, stroke, peripheral artery disease, heart failure, and coronary artery disease, hypertension can also lead to kidney damage, dementia, or blindness [6]. Early markers of the syndrome are often present before BP elevation is sustained; therefore, hypertension cannot be classified solely by discrete BP thresholds [7]. According to 2014, Eighth Joint National

Committee (JNC-8) guidelines on HTN, antihypertensive medications (blood pressure medication) should be initiated in patients less than 60 years old if the systolic blood pressure is persistently >140 mmHg and the diastolic blood pressure is persistently >90 mmHg despite non- pharmacologic therapy. If a patient is 60 years old and older, antihypertensive therapy should be initiated if the systolic blood pressure is >150 mmHg and the diastolic blood pressure is >90 mmHg[8].

While hypertension is well recognized as a major cause of morbidity and mortality in the economically developed world, the importance of hypertension in economically developing countries is well established [9]. On the basis of clinical and population research, increased blood pressure, hypertension and related complications are largely preventable. Nevertheless, most people with hypertension worldwide are not effectively treated and controlled to the recommended blood pressure targets. The treatment for hypertension includes antihypertensive drugs which helps in vasodilation viz Angiotensin converting enzyme inhibitors, beta blockers, calcium channel blockers, diuretics and nerve blockers[10], diet modifications, behavioural or lifestyle modifications and use of natural antihypertensive products[11].

Herbal plant-based formulations or drugs are pivotal to traditional practices in Chinese, Ayurvedic and Unani Tibb medicine, which is practiced worldwide[4]. Plants contain a bounty of phytochemicals that have proven to be protective by reducing the risk of various ailments and diseases. The usage of Complementary and Alternative Medicine in developing countries is becoming even more pronounced[12]. Indeed, plants and herbs have actually provided a starting point for synthesis of over 50% of currently used pharmaceutical drugs [13]. This is due to several factors, principal of which is that herbal medicine is a cheaper alternative with fewer undesired side effects[14]. The hypotensive and antihypertensive effects of some of these medicinal plants have been validated and others disproved. More scientific research needs to be done to verify the effectiveness, and elucidate the safety profile of such herbal remedies for their antihypertensive potential [4].

Coconut Neera (CN) is the vascular sap collected from immature unopened coconut inflorescence in fresh form. Young inflorescence of coconut palm of west coast tall variety is used for the preparation of Neera[15]. Neera is a natural and non-alcoholic beverage, high in nutritional value and an instant thirst quencher. It is sweet, oyster white, and translucent. It is obtained by slicing the spathes of coconut and scraping the tender most part, just below the crown. Neera is considered as a nutritious drink for the cure of anaemia, tuberculosis, bronchial suffocation and piles[16]. GI of Coconut Neera below 55 is considered low hence it is also good for weight maintenance, preventing over weight and obesity and good for diabetic people [17]. But scientific human studies on the therapeutic effects of Coconut Neera on metabolic diseases are lacking. Hence the **Anti-hypertensive Potential of Coconut Neera (*Cocos nucifera*, L.) on Hypertensive Adult Women** was carried out.

II. Materials and Methods

The area selected for the study was Convent Square in Alappuzha. The samples selected for the study was adult women with and without hypertension (Stage I hypertension) of age 30-60 years. The Joint National Committee (JNC-8)[18] categories was followed for classification of blood pressure. All biochemicals used for the study was obtained from Spectrum Chemicals PVT LTD. Other chemicals used were of analytical grade.

The sample chosen for the study was Coconut Neera (CN), a natural non- alcoholic beverage obtained from *Cocos nucifera*, L. of West Coast Tall Variety. The Coconut Neera used for the study was purchased fresh from the CN processing Plant at Ayyappancherry, Cherthala. The Coconut Neera, collected from the spade of the coconut is collected fresh by adding antifermenting solution 1.5g/l by the tapping agents to prevent the fermentation. The Coconut Neera tapped is golden brown

in colour. The Coconut Neera having pH between 5.0 and 6.5 and above is selected and those sample with pH below 5.0 is rejected.

Experimental Design:

The Adult Women selected (age 30-60 years) for the study was divided into four groups:

Group -1 Control (25)

Group -2 Control +Coconut Neera (25)

Group -3 Hypertensive Adult Women (25)

Group -4 Hypertensive Adult Women+ Coconut Neera (25)

Parameters viz Sugar, Protein, Sodium, Potassium, Calcium, Magnesium, Vitamin C and Polyphenols in Coconut Neera was analysed. Systolic pressure, diastolic pressure and serum total cholesterol was also estimated.

Blood Pressure was monitored using automated sphygmomanometer. Serum cholesterol was estimated by the cholesterol oxidase - peroxidase methodology (Enzy-colorimetric test) using the kit from Agappe Diagnostics, Thane, Maharashtra, India[19].

The sugar content was estimated by Somogyi [20]. method. Protein content of the coconut water was estimated by the method of Lowry [21]. after slight modification. Sodium, Potassium, Calcium and Magnesium were estimated by using flame photometry [22]. Vitamin C content was determined spectrophotometrically[23]. The total phenolic contents of samples were quantified by the FolinCiocalteu's reagent and were expressed as gallic acid equivalents[24].

III. RESULTS AND DISCUSSION

A. Composition of Coconut Neera used for the study

Table 1. Composition of Coconut Neera

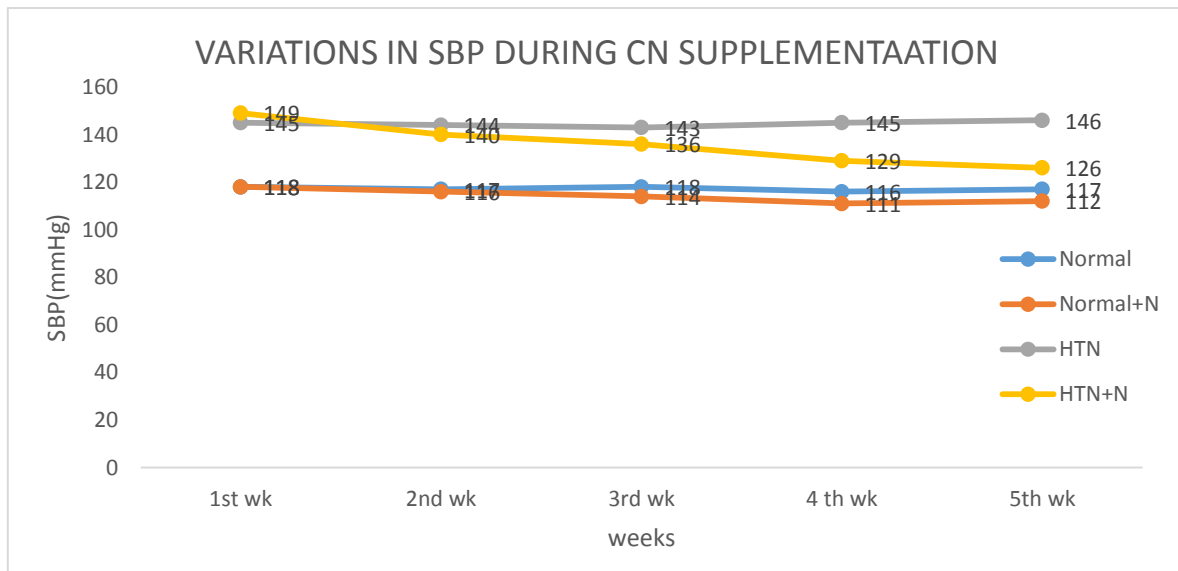
Parameters	Per 100ml
pH	5.0- 5.5
Sugar (g)	2.6
Total Protein(g)	0.23
Sodium(mg)	23.9
Potassium(mg)	91.6
Calcium(mg)	5.0
Magnesium(mg)	7.8
Vitamin C(mg)	17.0
Polyphenols(g)	0.04

The sugar content, total protein, sodium, potassium, calcium, magnesium, vitamin C and polyphenol content and glycaemic index of CN obtained from West Coast Tall variety was estimated

as shown in **Table 1**. Coconut Neera had an alkaline pH. It was found that CN possess macronutrients viz sugar and total protein along with electrolytes sodium, potassium, calcium and magnesium. Potassium to sodium ratio was found to be 4:1 ratio which was found favourable to maintain electrolyte balance. Antioxidant properties of Coconut Neera was indicated by the presence of Vitamin C and its Polyphenol content.

B. Systolic Blood Pressure of Subjects

Figure I. Variations in Mean Systolic Blood Pressure during CN Supplementation



Values are mean \pm SD of 25 subjects

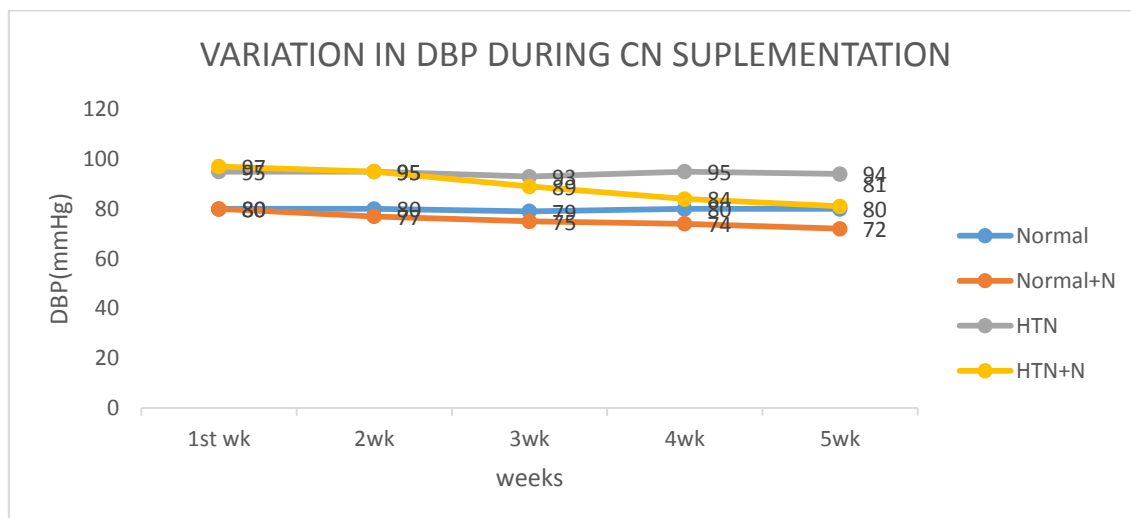
$P < 0.05$, ^a indicates the results are significantly different from group 1, ^b indicates that the results are significantly different from group 3.

The supplementation of neera was carried out for 5 weeks. **Figure I** clearly indicates the changes in SBP during the treatment phase. In control group treated with neera the SBP remained more or less same. In hypertensive group treated with neera the SBP significantly decreased from 149 ± 3 mmHg to 136 ± 3 mmHg towards third week and by fifth week the SBP was decreased to 126 mmHg ± 3 . The SBP in Hypertensive treated group was significantly ($P < 0.05$) different from the hypertensive group indicating the beneficial effects of CN in ameliorating hypertension.

Chemical analysis of CN shows that it contains Potassium, Calcium, Magnesium, Vitamin-C, Minerals and Free amino acids (L.-Arginine, cysteine, tyrosine etc.) reported to have antioxidant, and anti-hypertensive effects[25]. Nitric Oxide(NO) also called endothelium-derived relaxing factor (EDRF) is a free radical gas with a very short half-life released from endothelial cells in response to blood flow-induced shear stress and by activation of a number of receptors[26,27,28]. NO is synthesized from arginine by NO synthase (NOS) possessing vasodilator property[29, 30,28]. The study clearly shows that the antihypertensive effect of CN is mediated through the biologically active constituents in it, which possess significant hypolipidemic, anti peroxidative potential thereby normalizes NO pathway, contributes to anti-atherogenic effects, improvement of endothelial dysfunction, increased peripheral resistance which leads to decreased blood pressure. In addition, CN is reported to possess free and sulphur containing amino acids (L-Arginine, cysteine, and tyrosine) and antioxidant vitamins C and A which possess significant role in decreasing oxidative stress. ANOVA utilizing F –Test was used to find the significance difference in means between and within the groups. The blood pressure levels of hypertensive groups were found to be significantly different from the control group and treated group. Since $P < 0.05$ we accept the hypothesis that supplementation of CN ameliorates the blood pressure.

C. Diastolic Blood Pressure of Subjects

Figure II. Mean Variations in DBP During Coconut Neera Supplementation



Values are mean ± SD of 25 subjects

P<0.05, ^a indicates the results are significantly different from group 1, ^b indicates that the results are significantly different from group 3.

Figure II depicts the DBP changes in coconut neera. The DBP was significantly decreased from third week onwards in hypertensive treated group from 96 ±3 mmHg to 81±2mm Hg. The DBP of hypertensive treated group was significantly different from hypertensive group. The blood pressure lowering effects of coconut neera may be due to the various biological constituents in coconut neera viz calcium, magnesium, vitamin C, Polyphenol content, growth hormones, flavonoids and the sodium potassium ratio in coconut neera (1:4). The hypocholesterolaemic effects of coconut neera mediated by L-arginine and the favourable potassium- sodium ratiowhich helps in restoring electrolyte balance may be the reason for its antihypertensive effects. The population-based International Study of Macro/Micro-nutrients and Blood Pressure (INTERMAP) was designed to elucidate relations of multiple dietary factors to BP[31, 32].

D. Serum Total Cholesterol of Subjects

Table II. Mean Serum Total Cholesterol of Subjects

Sl. No:	Groups	Mean Total Cholesterol (mg/dL)	
		Before	After
1	Normal	176.24±6	171.44 ^b ±7
2	Normal+ CN	173.8±5	166.1 ^b ±5
3	HTN	266.9±5	265.7 ^a ±5
4	HTN + CN	274.5±9.7	209.8 ^b ±7.6
	F Value	961.30	

Values are mean ± SD of 10 subjects

P<0.05, ^a indicates the results are significantly different from group 1, ^b indicates that the results are significantly different from group 3.

Table II. shows the total serum cholesterol of hypertensives compared to control group. The serum total cholesterol was found to be raised among 76.5% of hypertensives (274.5 mg/dl±9.7) which was found to be significantly ($P<0.05$) reduced in neera treated group. The cholesterol levels of neera treated groups were significantly different from the hypertensive groups. ANOVA utilizing F –Test was used to find the difference in means between and within the groups. The blood pressure levels of Hypertensive groups were found to be significantly different from the control group and treated group. Since $P<0.05$ we accept the hypothesis that supplementation of CN ameliorates the hypercholesterolaemia.

It is a reasonable hypothesis that cholesterol intake is one among many dietary factors that in combination have major impact on BP[33]. Hypercholesterolemia may develop as a consequence of unbalanced diet, obesity, inherited(genetic) diseases (familial hypercholesterolemia), or other diseases (e.g., diabetes). There is a growing interest in nutraceuticals to treat and also prevent certain cardiac diseases or restore the injured adaptation of the heart. Natural food substances have the potential to alter biological functions of the cells by mechanisms enhancing the endogenous antioxidant systems or through altering the redox signalling status of the cell. This is often related to the unique composition of different antioxidant compounds in the various nutraceuticals which could be beneficial in pathological conditions where oxidative stress plays an important role[34]. The hypocholesterolaemic effects of CN may be due to the biological constituents viz Potassium, calcium, magnesium, L-arginine and antioxidant vitamins which reduces the endothelial injury by the antiatherogenic and antiperoxidative effects there by causing vasodilation. Researchers have found that a diet rich in refined and high-GI carbohydrates may substantially raise the risk for heart disease. These foods increase blood insulin levels, which in turn contribute to a higher blood pressure, higher levels of blood fats (triglycerides), lower levels of HDL (good) cholesterol and an increased tendency for dangerous clots to form and linger in the blood. Inositol present in CN is reported to reduce high cholesterol, good for heart and formation of healthy cells in the body[35].

IV. Conclusion

The use of carefully chosen herbal remedies and dietary supplements can help to lower blood pressure, as well as to improve the overall functioning of heart, arteries, and entire cardiovascular system. Coconut Neera supplementation (100ml/day) was found to be effective in the management of hypertension and its related complications without any side effects which may be attributed due to the presence of active biological constituents and the following therapeutic effects viz antioxidant, hypolipidaemic, hypoglycemic, diuretic and antihypertensive effects. The antihypertensive effect of CN is mediated through normalization of NO pathway and calcium channels which contributes to anti-atherogenic effects and improvement in endothelial dysfunction and increased peripheral resistance which leads to decreased blood pressure. In addition, the presence of free and sulphur containing amino acids (L-Arginine, cysteine, and tyrosine) and antioxidant vitamins C and A possess significant role in activation of antioxidant system thereby reducing oxidative stress. In short, Coconut Neera possess significant hypolipidaemic and antihypertensive effects.

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