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Original Research Article

Use of *Achyranthes aspera* Linn Tea as Antidiabetic and Hypolipidemic Herbal Tea

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ABSTRACT

Objective: To investigate the effects of *Achyranthes aspera Linn* tea on blood glucose and blood lipids, of alloxan- induced diabetic rats.
Methods: The stem, leaves and flowers of *Achyranthes aspera Linn* plant; one of the traditional antidiabetic plant used in many countries were collectively processed into a herbal tea. Proximate and phytochemical compositions of the herbal tea were determined. Antidiabetic and hypolipidemic properties of the herbal tea were evaluated on five group of rats: NC (non-diabetic rat group given rat feed and tap water), DC (diabetic rat group given rat feed and tap water), CON1 (diabetic rat group given rat feed and 1 g/100 ml of herbal tea), CON2 (diabetic rat group given rat feed and 2 g/100 ml of herbal tea) and CON3 (diabetic rat group given rat feed and 3 g/100 ml of herbal tea). Feed, water and herbal tea were provided *ad libitum* for the respective groups for twenty one days. The average fasting blood glucose concentrations of the different groups were determined every week while the lipid profile was determined at the end of the treatment period.
Results: Results showed that the herbal tea contains alkaloids, tannins, phenolics, saponins, flavonoids, phytosterols and cardiac glycosides. The average fasting blood glucose concentrations of CON1, CON2 and CON3 dropped from 370.4 mg/dl to 302.6 mg/dl; 366.0 mg/dl to 229.4 mg/dl and 383.4 mg/dl to 259.2 mg/dl respectively while that of DC increased from 357.8 mg/dl to 496.17 mg/dl after 1 week of administration. The herbal tea had no effect on mean serum TCH, HDL and LDL cholesterol but caused significant reduction in mean serum Triglyceride in CON1, CON2 and CON3.

Keywords: *Achyranthes aspera Linn,* Antidiabetic, Herbal Tea, Hypolipidemic

1. INTRODUCTION

Achyranthes aspera Linn plant is a small, much branched, monoecious, perennial subshrub that is found on wastelands or along flood areas of the tropics and subtropic regions of the world. It belongs to the family Amaranthaceae. [1] It is known in English as 'rough chaff tree' and in Nigeria as 'aboro' or 'abora' by Yorubas, 'ọdụdụ ngwele' or 'nri atụlụ' by Ibos and 'kibanka dangaru' by Hausas. It is rarely eaten as vegetable, rather, it is fed to animals especially sheep, goat and cow as foliage.

It is a known plant drug whose flowers, leaves and stems have been used in different traditional medicines of the world such as ayurvedic, allopathic, homeopathic, naturopathic and home remedies for the treatment of different kinds of diseases such as vomiting, bronchitis, heart disease, piles, itching, abdominal pains, ascites, dyspepsia, dysentery, sprains, asthma, hypertension, diabetes, wound dressing etc. [2- 11]

Pharmacological studies have shown that *Achyranthes aspera Linn* plant contains alkaloids, tannins, cardiac glycosides, steroids, flavonoids, terpenoids, reducing sugar and saponin in appreciable quantities. [12] It also has a lot of medicinal values such as promotion of thyroid hormones activities, [13] antifertility activity, [14] antihyperlipidemic activity, [9,14] antidiabetic activity, [15] antitumor promoter activity, [7] immuno-stimulatory activity, [16] anti-inflammatory activity [9] and antimicrobial activity. [9,17] However, the aqueous extract of the plant has been shown to stimulate the demineralization of matrix-bound minerals. [18]

In the traditional use of *Achyranthes aspera Linn* plant in treatment of diseases in Nigeria, it is often prepared and administered as infusions, tinctures or decoctions that possess both strong odor and awful taste. This, together with its mode of preparations and the mystics attached to traditional medicine, make its use in traditional medicine unacceptable to many people.

Transforming this wonderful plant into herbal tea as a substitute for its local infusions, tinctures or decoctions used in traditional medicine will not only increase its acceptance in treatment of diseases but will also make it more convenient for use and easily available. In this work therefore, *Achyranthes aspera Linn* plant was processed into a herbal tea and its effects on blood glucose and blood lipids, were investigated on alloxan- induced diabetic rats.

2. MATERIALS AND METHODS

2.1 Plant materials

Different parts of *Achyranthes aspera Linn* plant (leaves, stem and flowers) free from diseases were collected from uncultivated farmland in Owerri, Imo State, Nigeria and authenticated at the Department of Crop Science, Federal University of Technology, Owerri. The plant materials were taken to the Food Science and Technology Laboratory for processing and animal studies.

2.2 Processing of Achyranthes aspera Linn Tea

The leaves, stems and flowers of *Achyranthes aspera Linn* plant were collectively processed into a herbal tea (*Achyranthesaspera* Tea) following a modified method of green tea processing as described by. [19]

The leaves, stems and flowers were washed together and pan-fried for two minutes to denature the endogenous enzymes. After pan-frying, they were coarsely ground together, sun-dried to about 15% moisture, and then packaged in polyethylene bags for animal studies.

2.3 Proximate Analysis

The *Achyranthes aspera* tea was analyzed for proximate composition (moisture, fat, protein, fibre, ash, carbohydrate) using the methods described by AOAC. [20]

2.4 Phytochemical Screening

Qualitative screening of the herbal tea was carried out using standard procedures to identify the presence of bioactive compounds in the herbal tea sample as described by Sofowara [21] and Trease and Evans. [22]

2.5 Animal Studies

A total of 70 mature, male albino rats (*Rattus norvegicus*) of Wistar strain were sourced from Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria. Upon arrival, the animals were allowed to acclimatize for seven days while being maintained on regular commercial rat feed (Vital Feed, Growers; produced by UAC, Nigeria) and tap water.

2.5.1 Experimental Design

The rats were acclimatized for seven days and after were fasted overnight. Diabetes was induced in 65 rats using a single dose of alloxan monohydrate prepared with saline at 125mg/kgbwt given intraperitoneally, while the remaining 5 rats received saline injection intraperitoneally too and served as the nondiabetic rats. Three (3) days after injection of alloxan and saline, the blood glucose concentrations of the rats were

taken, (blood glucose at confirmation of diabetes) and only rats with blood glucose above 250mg/dl were selected for this study. The nondiabetic and diabetic rats were grouped according to the following treatment groups: NC (non-diabetic rat group given tap water and rat feed), DC (diabetic rat group given tap water and rat feed), CON1 (diabetic rat group given1mg/100ml of *Achyranthes aspera* tea and rat fed), CON2 (diabetic rat group given 2mg/100ml of *Achyranthes aspera* tea and rat fed), CON3 (diabetic rat group given3mg/100ml of *Achyranthes aspera* tea and rat fed). Water, tea and feed were made available to the different rat groups *ad libitum* from the day of confirmation of diabetes (day 0) to the end of the treatment period (day 21). The average fasting blood glucose concentrations of the non-diabetic rat group NC and that of the diabetic rat group DC that took tap water and rat feed and those of the diabetic rat groups CON1, CON2 and CON3 that took different concentrations of the herbal tea and rat feed were measured every week from the day of confirmation of diabetes to the final day of administration of the herbal tea. At the end of the treatment period, the animals were fasted overnight and their blood specimen collected by cutting of their jugular veins (slaughter) after immobilization. Blood samples collected were used for blood glucose determination and lipid profile analysis.

The established ethical framework on the use of laboratory animals as described in section 7.0 of the research policy regulations of the Federal university of Technology Owerri, Nigeria was adopted in this animal study.

2.5.2 Biochemical analysis

2.5.2.1 Blood Glucose Determination

Blood samples were collected from the tail arteries of the rats from the various treatment groups (DC, CON1, CON2, CON3) on day zero (day of confirmation of diabetes) and every 7 days till the end of the treatment period (day 21) and their blood glucose determined using One Touch Ultra glucometer, the values were expressed in mg/dl.

2.5.2.2 Lipid Profile Analysis

Serum Total cholesterol (TC), High Density Lipoprotein (HDL) cholesterol and Triglyceride (TG) of the blood samples were assayed using commercial test kit procedure by Random Laboratories Ltd, Antrim, United Kingdom, Biosystems S. A. Barcelona Spain. Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein were estimated by difference. [23]

2.5.2.3 LDL/HDL Ratio: This was calculated using the equation below

$$\frac{\text{LDL value}}{\text{HDL value}}$$

3. RESULTS

3.1 Proximate composition of Achyranthes aspera Linn Tea

The results obtained for the proximate composition of *Achyranthes aspera* tea in percentage dry weight basis are shown in Table1 below.

Table 1: Proximate Composition of *Achyranthes aspera Linn* Tea (% DW)

Moisture (%)	21.70 ± 1.81
Crude fat (%)	2.02 ± 0.45
Crude protein (%)	15.28 ± 0.45
Fiber (%)	13.90 ± 0.01
Ash (%)	14.17 ± 0.72
Carbohydrate (%)	32.93 ± 2.00

Mean of three determinations.

3.2 Phytochemical Screening

Result of the phytochemical Screening conducted on the herbal tea sample is shown on Table 2 below.

Table 2: Phytochemical Constituents of *Achyranthes aspera Linn* Tea

Alkaloids	+
Tannins	+
Phenolics	+
Saponins	+
Flavonoids	+
Phytosterol	+
Cardiac glycosides	+
Phlobatannins	-
Cyanogenic glycoside	-

+ indicates presence while – indicates absence

3.3: Effects of Different Concentrations of Achyranthes aspera Linn Tea on Fasting Blood Glucose Concentration

The effects of different concentrations of *Achyranthes aspera Linn* tea on average fasting blood glucose concentrations of the treatment groups NC, DC, CON1, CON2 and CON3 are shown in Figure 1. At day 0 (day of confirmation of diabetes), the average fasting blood glucose concentrations of all the diabetic groups DC, CON1, CON2 and CON3were 357.8 mg/dl, 370.4 mg/dl, 366.0mg/dl and 382.4 mg/dl respectively which were more than 3 times higher than that of the non-diabetic group NC (90.4 mg/dl), indicating that the drug (alloxan-monohydrate) was able to induce diabetes on the rats injected. At the end of the first week (day 7) of administration of *Achyranthes aspera* tea, the average fasting blood glucose concentrations of the diabetic groups CON1, CON2, and CON3 which took 1g/100ml, 2g/100ml and 3g/100ml of *Achyranthes aspera* tea dropped to 302.6 mg/dl, 222.9 mg/dl and 259.2 mg/dl respectively while that of the diabetic group DC which took tap water in place of the herbal tea increased to 496.17 mg/dl. After the first week, the values of all the diabetic groups DC, CON1, CON2 and CON3 increased and continued in like manner throughout the rest of the treatment period. The fasting blood glucose concentration of the non-diabetic group NC that took tap water in place of *Achyranthes aspera* tea remained basically stable throughout the treatment period.

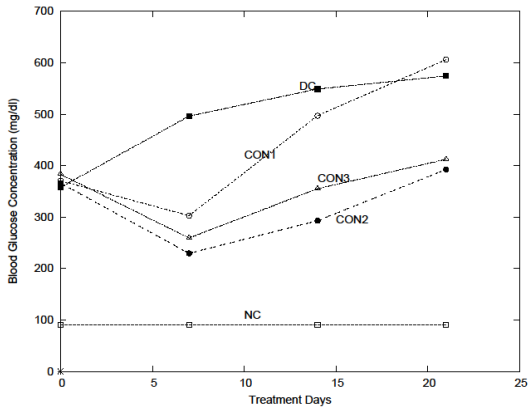

Fig 1 Effects of Different Concentrations of Achyranthes aspera Linn Tea on Fasting Blood Glucose Concentration
NC (non-diabetic group that took tap water and commercial rat feed),
DC (diabetic group that took tap water and commercial rat feed),
CON1 (diabetic group that took 1 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)
CON2 (diabetic group that took 2 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)
CON3 (diabetic group that took 3 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)

3.4 Effect of Different Concentrations of Achyranthes aspera Linn Tea on Serum Lipid Profile

The results of the lipid profile analysis of the different treatment groups NC, DC, CON1, CON2 and CON3 are shown in Figure 2 below.

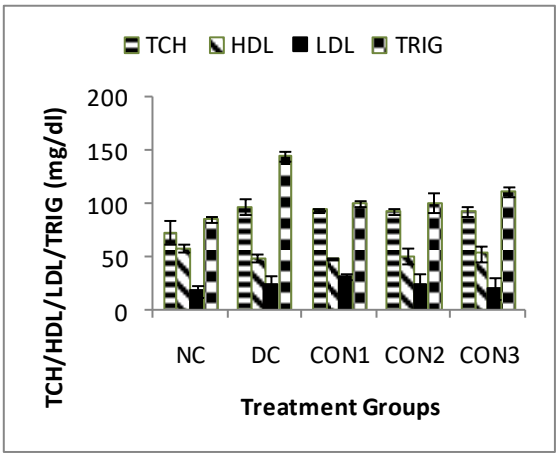

Fig 2 Effect of Different Concentrations of Achyranthes aspera Linn Tea on Serum Lipid Profile
NC (non-diabetic group that took tap water and commercial rat feed)
DC (diabetic group that took tap water and commercial rat feed),
CON1 (diabetic group that took 1 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)
CON2 (diabetic group that took 2 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)
CON3 (diabetic group that took 3 g/100 ml of *Achyranthes aspera* tea and commercial rat feed)

4. DISCUSSIONS

The result of the proximate composition of the *Achyranthes aspera Linn* tea showed that the tea has moisture content of 21.70% which was higher than the value 6.5 % suggested by Owuor [24] for tea products; reason for this could be attributed to the drying method (sun-drying) employed in its processing. The crude protein (15.28 %) was also significantly lower than the values obtained for some common edible Nigerian vegetables (bitter leaf, Indian spinach, bush-buck, scent leaf, *Amaranthus hybridus*, *Hibiscus sabdariffa* and *Telfairia occidentalis*), [25] indicating poor source of plant protein.

The medicinal properties of the phytochemicals contained in this herbal tea

have been shown in literatures but worthy of mention are the flavonoids and phenolics which are antioxidants shown to prevent oxidative damage of bio-molecules such as lipids, proteins and DNA which play roles in the development of chronic diseases such as cardiovascular diseases and cancer. [26-28] Tannins are also shown to modify the imbalance of lipids and glucose homeostasis thereby reducing the risk of metabolic syndrome and type 11 diabetes complications. [29]

The pronounced decrease in the average fasting blood glucose concentrations of CON1, CON2 and CON3 groups after the first week of administration of the herbal tea as shown in Fig 1 could explain the reason why *Achyranthes aspera Linn* plant is used locally for the management of diabetes mellitus; hence it gives a quick drop in blood glucose when administered. [30-32] However, the continuous increase in the average fasting blood glucose concentrations of the group CON1, CON2 andCON3 that took different concentrations of the herbal tea, after the first week of administration agrees with the findings of Geetha [33] who noted that ethanolic extract of *Achyranthes aspera Linn* plant caused 20% increase in blood glucose at fifteen day of administration. The increase in blood glucose observed after the first week indicates that the reduction effect exerted by the herbal tea on the first week could not be sustained for a long time. The reason for this is not well understood but could be attributed to resistance of the body to the active principles responsible for this action.

At the end of the treatment period, CON2 and CON3 which were the groups that took 2 g/100 ml and 3 g/100 ml of the herbal tea had average fasting blood glucose concentrations of 392.4 mg/dl and 412.2 mg/dl respectively which were much lower than that of the group DC (574.17 mg/dl) which took tap water in place of the herbal tea.CON1 group which took 1 g/100ml of the herbal tea had average fasting blood glucose concentration of 606.2 mg/dl which was higher than that of group DC (574.17). The reason for this could be attributed to the initial higher value of CON1 (370.4 mg/dl) when compared with that of group DC (357.8 mg/dl) at the day of confirmation of diabetes.

Fig 2 shows that the mean serum Total Cholesterol and Triglyceride were highest in group DC (diabetic group that took water) and lowest in group NC (non-diabetic group that took water) confirming the works of Orchard [34] and Betteridge [35] which showed that diabetes mellitus increases mean serum Total Cholesterol and Triglyceride. The diabetic groups CON1, CON2 and CON3 that took different concentrations of the herbal tea all showed significant reduction (P>0.05) in mean serum Triglyceride and slight reduction in Total Cholesterol when compared with that of the diabetic group DC. This is in line with findings of Geetha [33] who noted reduction in mean serum Total Cholesterol when ethanol extract of *Achyranthes aspera Linn* plant was administered to alloxanised mice. Significant reduction effect of the herbal tea in serum Triglyceride shows that intake of the herbal tea will go a long way in combating prevalence of cardiovascular diseases, type 11diabetes and obesity which are all associated to hypertriglyceridemia. [36-38] However, the inverse relationship between HDL-cholesterol levels in serum and the incidence/prevalence of coronary heart disease (CHD) and the direct relationship between LDL-cholesterol in serum and incidence/prevalence of coronary heart disease have both been demonstrated in a number of epidemiological studies. [39,40] Thus, while in the past, the increase in serum Total Cholesterol was associated with increased risk of atherosclerosis, recent reports now indicate LDL/HDL ratio as a stronger index of atherogenicity of the lipoproteins rather than the lipid profile of individual lipoprotein fractions, thus the lower the ratio the less atherogenic the lipoprotein profile. [41] Thus, when the LDL/HDL values of the treatment groups were calculated, the result showed that NC

had 0.303±0.08, DC (0.503±0.19), CON1 (0.667±0.07), CON2 (0.497±0.28) and CON3 (0.410±0.25), indicating, that the herbal tea had more positive effect in reducing atherogenicity at 3mg/100ml of administration.

CONCLUSION

The effects of *Achyranthes aspera* tea on blood glucose and lipids showed that the herbal tea had significant reduction on blood glucose after first week of administration and significant reduction on serum Triglyceride but had no effect on HDL and LDL cholesterol.

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