International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 6 Issue 2, February 2019

ISSN: 2394-4404

Effect Of Ginger (Zingiber Officinale) Consumption As Nutritional Management Recipe On Lipid Profile And Hepatosteatosis Status Of Non-Diabetic Patients With Non-Alcholic Fatty Liver Disease

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Abstract: ***The study focused on the effect of ginger (Zingiber Officinale) consumption as nutritional management recipe on lipid profile and hepatosteatosis status of non-diabetic patients with non-alcoholic fatty liver disease. NAFLD is one of the major cause of liver injury and has become common in recent times. Since there is no acclaimed cure for NAFLD, the need arose to find natural means of ameliorating the effect of the disease on the liver through spices and plants proven to have antioxidant, anti-inflammatory properties like ginger. Ginger sample was administered on patients with NAFLD in three different means and group. One group took the ginger recipe blended and mixed with water, another group took cake prepared from ginger and what flour and the last group swallowed 500mg cloves of ginger cut. Results from the study revealed that ginger had significant effect on BMI, serum cholesterol, LDL cholesterol, AST, ALT and GGT. Multiple comparison analysis further showed that the ginger nutritional therapy significant differed between the group in line with the parameters determined.***

Keywords: Ginger, Hepatosteatosis, Non-alcoholic liver disease, lipid profile, ultrasound

I. INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is the term for a range of conditions caused by a build-up of fat in the liver usually seen in people who are overweight or obese with absence of alcohol comsumption. NAFLD develops first from simple fatty liver (steatosis) which consist of a largely harmless build-up of fat in the liver cells. The next stage may proceed to non-alcoholic steatohepatitis (NASH) which is a more serious form of NAFLD, where liver becomes inflamed and then fibrosis where the persistent inflammation causes scar tissue around the liver and nearby blood vessels. The last stage is the most severe stage, cirrhosis occurring after years of inflammation, where the liver shrinks and becomes scarred and lumpy. Cirrhosis damages the liver permanently and can lead to liver failure or liver cancer (Bedogni, Nobili, & Tiribelli, 2014).

NAFLD has become common worldwide. In Nigeria and Sub-Saharan Africa, NAFLD is one of the chronic liver disease resulting from the endemicity of viral hepatitis B and type II diabetes mellitus (DM) (Onyekwere, Ogbera, & Balogun, 2011), predominance of sedentary lifestyle and obesity (Ong & Younossi, 2007). Nonalcoholic fatty liver disease occurs in every age group but especially in people in their 40s and 50s who are at high risk of heart disease because of such risk factors as obesity and type 2 diabetes. The condition is also closely linked to metabolic syndrome, which is a cluster of abnormalities including increased abdominal fat, poor ability to use the hormone insulin, high blood pressure and high blood levels of triglycerides, a type of fat.

Some of the common symptoms of NAFLD include dull or aching pain in the top right of the abdomen, extreme tiredness, unexplained weight loss and weakness. If Cirrhosis develops, symptoms may include yellowing of the skin and the whites of the eye (jaundice), itchy skin, swelling in the legs and ankle, feet or tummy. NAFLD is often diagnosed after a blood test called a liver function test produces an abnormal result and other liver conditions, such as hepatitis, are ruled out. The condition may also be spotted during an ultrasound scan of the abdomen. When diagnosed with NAFLD, further tests may be needed to determine which stage. This may involve a special blood test or having another type of ultrasound scan (Fibroscan). Some people may also need a biopsy, where a small sample of liver tissue is taken using a needle so it can be analysed in a laboratory.

Studies by Studies Than and Newsome (2015) shows that globally, 16% normal individuals without metabolic symptoms have NAFLD with a sharp increasing prevalence in obese, diabetic, hyperlipidemia and patient above 60 years of age. Data from National Health and Nutrition Examination Surveys shows that there is a steady increase of NAFLD as a major cause of (over 75%) of chronic liver disease in the United States alone . NAFLD has affected an estimated 5% of UK population (National Health Service, NHS, 2019).

In Africa and Nigeria in particular, the prevalence of NAFLD is not known. However, earlier studies by Onyekwere, Ogbera, and Balogun (2011) reveal that prevalence rate of NAFLD was higher in the DM cases. According to the study central obesity as measured by waist circumference (WC) and SGPT levels were significantly higher in people with fatty liver. The mean body mass index (BMI) of diabetic and non-diabetic patients was similar (31 *vs.* 30 kg/m2). The prevalence of the metabolic syndrome was higher in the subjects with NAFLD than in those without fatty liver disease but the difference was not statistically significant. Onyekwere, Ogbera, and Balogun concluded that non-alcoholic fatty liver disease is present in Africa but is less than what one would expect based on American and European studies.

In recent times however, the occurrence of NAFLD appear to be on the increase. The case is therefore, no longer about its occurrence but about medical solutions to ameliorate the disease. According to NHS (2019), there is currently no specific medication for NAFLD, but making healthy life choices can help. One such choice is the management of nutritional recipes by patient with the help of professional dieticians or nutritionists. Recommendations and nutritional therapy adopted by most Nigerians include the use of herbal concoctions and vegetable often involving such plants as ginger (*Zingiber Officinale).*

Ginger (*Zingiber officinale*) is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine (Ross, 2008). It is a herbaceous perennial which grows annual pseudostems (false stems made of the rolled bases of leaves) about a meter tall bearing narrow leaf blades. Ginger produces a hot, fragrant kitchen spice. Young ginger rhizomes are juicy and fleshy with a mild taste. They are often pickled in vinegar or sherry as a snack or cooked as an ingredient in many dishes. They can be steeped in boiling water to make ginger herb tea, to which honey may be added (Lee & Oh, 2013). Ginger can be made into candy or ginger wine. Ginger is known to possess so many health benefits.

Ginger has been revered as a culinary and medicinal spice in many traditional cultures. It is also a very powerful remedy with numerous proven health benefits from reducing nausea (Tiran, 2012) and PMS symptoms to fighting inflammation (Thomson, Al-Qattan, Al-Sawan, Alnaqeeb, Khan & Ali, 2002) reducing muscular pain, easing menstrual cramps, boosting testosterone, allergies and asthma, and skin infection (Nattha & Ana, 2018). Many active components in ginger and its essential oil, such as gingerol and shogaol, are potent antioxidants (Oboh, Akinyemi, & Ademiluyi, 2012). They can scavenge free radicals throughout the body and neutralize them crucial for preventing numerous chronic diseases. The wide benefit of gender makes it a common inclusive cooking ingredient in many cultures across Nigeria. However, the role of ginger in nutrition and its effect on NAFLD among non-diabetic patients is not widely known. The study sought therefore, to examine whether ginger consumption as a nutritional management therapy will have any effects on the lipid profile and hepatosteatosis status of non-diabetic patients with NAFLD.

PURPOSE OF THE STUDY

The study examined the effect of ginger consumption as nutritional management recipe on lipid profile and hepatosteatosis status of non-diabetic patients with non-acholic fatty liver disease. Specifically, the study sought to find out the:

- ✓ Effect of ginger consumption on the lipid profile (total cholesterol, HDL-C, LDL-C and triglycerides) of non-diabetic patients with NAFLD.
- ✓ Effect of ginger consumption of the hepatosteatosis status of non-diabetic patients with NAFLD.

II. METHODOLOGY

PARTICIPANTS (SUBJECTS)

The participants in the study were students from the Faculty of Arts, Federal College of Education (technical), Umunze. The students at all level of education were reached by the researcher who educated them about NAFLD and the current study. Students were requested to participate in their study and were required to put down their names with their class coordinators if they wish to participate after the procedure for the experiment was explained to them. The coordinators registered the students at the home economic laboratory of the school. Incentives were provided as a motivation factor for students who gave their consent to the coordinators. The incentive was to mobilize them to the laboratory where they had ultrasound scan. Criteria for inclusion were that students must have fatty liver and have not been taking alcohol more than twice a week. Students must also live in the school hostel or within 1 mile from the school to be included in the study. Five copies of the study proposal and signature consent obtained from the participant were submitted to the research and ethical committee of Federal

College of Education (Technical) Umunze and their approval were obtained.

COLLECTION, PREPARATION AND ADMINISTRATION OF GINGER RECIPE

The ginger samples for the study were purchased from Ochanga market, Onitsha. The ginger were washed, peeled and allowed to dry in open air. The cloves were then cut manually using a kitchen knife. 1000 mg of the cloves were weighed and kept is clean plastics containers or wrapped with aluminium foil. The same procedure was used to prepare the sample every week and given to the participants weekly. The weekly administration was to make sure the samples were fresh and the participants closely monitored. All participants with NAFLD including the control group were requested to exercise at least 20 minutes a day and to modify their food intake. The participants were divided into 4 groups: control group with no treatment, group 1 which took the sample by blended and mixed with water (BMW), group 2 who took samples of cake prepared with wheat flour and ginger without sugar (WFS), group 3 who were given 1000mg ginger cloves to swallow (GCS). Participants who eat the cake prepared with ginger received fresh supplies of the cake from the researchers on the beginning and middle of the weeks.

ANTHROPOMETRIC MEASUREMENTS

The weight of the participants was measured by the researcher and trained research assistants in duplicate to the nearest 0.1kg, using full body sensor, body composition monitor and scale (Omron model HBF 516, omron heathcare, USA), with participants standing erect. Participants were required to be in light clothing, and were asked to remove jackets shoes and all other heavy objects including phones before standing on the scale. The heights of the participants were measured in duplicate to the nearest 0.1cm with a portable standiometer attached to a prestige analogue scale. The participants stood upright against the standiometer with the back of their heels and occiput touching the wall of height measure. The body mass index was calculated for each participant using their height and weight data With abdomen relaxed, a horizontal measurement (cm) was taken at the waist while the subject stood erect and in upright position, a horizontal measurement was taken at the level of maximum circumference of the hips/buttocks. The subjects were made to stand with feet together and arms at the sides. The waist circumference was measured at the halfway point between the lowest rib and the iliac crest in the mid auxillary line. The tape was wrapped horizontally around the entre circumference of the waist and on hip at different times. The measurement was repeated for two times in each case for consistency (cm). Both BMI and waist-hip ratio were determined with the data entered in Microsoft Excel data sheet version 2013. A waist circumference greater than 102cm in men and greater than 88cm in females in considered being substantially central obesity. While a waist-hip ratio (WHR) greater than 0.9 in men and greater than 0.85 in females defines obese individual.

DETERMINATION OF LIPID PROFILE, HEPATOSTEATOSIS STATUS

Participants who had liver size greater 14cm and echogenic had venous blood samples collected after taking aseptic precautions. 5 ml of blood was collected in plain vaccum tubes and 2 ml of blood was collected in EDTA vaccum tubes. Samples were left for 20 minutes at room temperature, and centrifuged at 3000 rpm for 4 to 5 minutes. Alkaline phosphatase (ALP), Alanine transaminase (ALT), Aspartate transaminase (AST), γ-Glutamyl transferase (GGT), total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were estimated using serum and semi-automated Mindray BA-88A chemistry analyser. An ultrasound based on the echogenicity and size of the liver was used for fatty liver determination. The examination of liver was carried by using Samsung Medison UGEO and GE voluson P8. The size of the liver was measured in midclaviclar line longitudinally and <14 cm was taken as controls and >14 was considered as hepatomegaly. Analysis of data (mean, standard deviation, ANOVA, post-hoc) was done using SPSS version 20. The results were reported as mean±standard deviation (SD). P-values less than 0.05 were significant while those above 0.05 were not significant. Significant difference between groups for any parameter warranted a post-hoc analysis to determine the direction of significance.

III. RESULTS

PRESENTATION OF RESULTS

Comparison of anthropometric measurements (BMI, WHR) liver size and liver function test between participants in groups 1 (BMW), group 2 (WFG), group 3 (GCS) and group 4

Parameters	Control (n=12) Mean±SD	Group 1(n=9) Mean±SD	Group 2 (n=14) Mean±SD	Group 3 (n=7) Mean±SD	P-Value	MP
Age	23.92±0.29	22.33±0.71	22.43±0.85	23.00±1.73	.001*	a*b*
BMI	28.08±2.75	26.00±1.12	29.21±2.78	29.71±4.61	.046*	
WHR	0.94±0.04	0.96±0.03	0.94±0.04	0.97±0.02	.151	
Liver size	16.25±2.14	16.22±0.44	16.50±1.09	16.43±0.98	.955	
Serum cholesterol (mg/dl)	170.83 ±17.84	181.11 ±9.55	168.71 ±16.22	187.43±17.54	.047*	
Serum Triglycerides (mg/dl)	206.50 ±28.60	173.56 ±46.96	181.29 ±23.68	175.71±18.55	.064	
HDL cholesterol (mg/dl)	39.50±9.04	35.00±3.24	34.29±2.05	41.29±9.11	.050	
LDL cholesterol (mg/dl)	134.17 ±26.64	125.11 ±16.92	104.64 ±12.08	118.71±35.94	.017*	b*
AST (IU/L)	29.25±7.66	33.78±1.79	36.50±5.02	26.00±4.55	.001*	a*b* e*f*
ALT (IU/L)	24.33±2.71	31.78±4.18	38.50±3.55	26.00±7.53	.000*	a*b* d*f*

ALP (IU/L)	59.67±11.28	68.44±13.39	72.86±13.54	73.43±14.37	.060	
GGT (IU/L)	25.25±6.03	34.78±10.74	35.71±11.15	38.00±8.12	.016*	

Data expressed as mean±SD, p-value ≤0.05 (*) considered statistically significant
MP, multiple comparisons using scheffe post-hoc for parameters with group differences that are significant
a= control vs group 1blended and mixed with water (BMW)*
b= control vs group 2 wheat flour and ginger without sugar (WFG)*
d= group 1 (BMW) and group 2 (WFG)*
e= group 1 (BMW) and group 3 ginger cloves swallowed (GCS)*
f= group 2 (WFG) and group 3 (GCS)*

Table 1

ANALYSIS OF RESULT

Sixty subjects were involved in the study and were randomly assigned to the groups. Three subjects in the control group withdrew due to unwillingness to continue, six withdrew from group one, one withdrew from group two and eight withdrew from group three all due to the unwillingness to continue. In group three particularly, subjects complained about having to swallow the cloves and given its odour and similar reasons were given by those in group one. Group two has the higher retention of subjects, who saw the cake as an additional snack which they could use as appetizer as students.

The age range of the subjects was 18-27 years and significant difference was observed between the ages of subjects in control group and group one and between control group and group two. There were significant difference between the BMI, serum cholesterol, and GGT of the groups but no significant difference was observed between any two groups in the post-hoc analysis. Significant group difference in groups LDL cholesterol shows that only control group and group two differed significantly. The major significant difference between groups was observed in their AST and ALT. Group one and control, group two and control, group one and group three and, and finally group two and group three differed significantly in their AST readings. For ALT, significant differences were observed between group one and control, group two and control, group one and group two, and finally in group two and group three.

IV. DISCUSSION

The prevalence of NAFLD is not accurately known in Nigeria and Africa at large. However, the frequent occurrence of NAFLD even among young adults is becoming a worrisome issue. Changes in educational settings where these young adults are found is one of the contributory factors to the slight increase in the disease. Students hostels are built within school environment resulting is less walking activities to lectures. In Nigerian institutions, gaming activities commence either at the end of the session or during host states' cultural or sport fiesta. Sports facilities are readily available and available one receive low patronage from students. Students barely visit the jim. Thus, student lifestyle is sedentary is one sense. It is also noticeable that due to academic demands and stress, students give high patronage to junk foods and reachable fast food outlets. Quite often, common foods available in these outlets are food substances rich in fat, sugar and at least foods with high glycemic indices. The scenario suggested the need for an organic way of reducing the accumulation of fat which in the case of accumulation in the liver cells results in NAFLD.

NAFLD is may be benign when it involves simple hepatosteatosis but when fats are accumulated beyond check limits, NAFLD results in hepatic injuries. Such liver injuries as hepatocyte injury, inflammation and fibrosis, which can lead to cirrhosis (Erickson, 2009). The accumulation of lipids, mainly triacylglycerol (TAG), in hepatocytes according to Hwayong, Youn-Hwan, Dong-Gun, Jongwook and Jin (2015) is the hallmark feature of the pathogenesis of NAFLD. Hwayong et al. (2015) confirmed the reports by Browning and Horton (2004) that the increased transport of FFAs into hepatocytes leads to enhanced hepatic *de novo* lipogenesis with excessive hepatic FFA β-oxidation and very low-density lipoprotein (VLDL) export, resulting in hepatic steatosis. Although the disease can be managed by improvement of lifestyle (diet, exercise and weight reduction) and cardiometabolic risk factors via controlling elevated cholesterol, triglyceride, and blood sugar, there are still no drug treatment options for NAFLD (Hwayong et al., 2015). Thus, spices and medicinal plants which have pleiotropic pharmacological activities, such as anti-inflammatory, antioxidant and cardiovascular activities becomes an alternative for NAFLD. One of such plant known to possess these features is Ginger (*Zingiber officinale).*

In this study, administration of ginger resulted in significant weight loss leading to improved BMI, reduction in serum cholesterol, LDL cholesterol; AST, ALT and GGT of participants proving that ginger possess medicinal properties that portend its potency for the nutritional management of NAFLD. More studies are therefore, required to exhaustively examine the potency of ginger as a medicinal plant and extract its phytochemicals components for production of more organic recipe for nutritional management therapies.

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