DETERMINATION OF THE EFFECT OF GUM ARABIC ON BODY WEIGHT AND SOME BIOCHEICAL PARAMETERS ON ALBINO WISTAR RAT

ABSTRACT

This experiment studied the effect of different concentration of Gum Arabic as a supplementary diet and its effect on lipid profile, glucose level and some enzyme activity on Albino rats. Sixteen Albino rats of nine (9) weeks of age were divided into four (4) groups; each group had four (4) rats. Three (3) groups were feed with oral dose of Gum Arabic at different concentrations (200mg/kg , 400mg/kg , 600mg/kg) for two(2) week and the other was used as the control. The study revealed that in serum, there was a sentific significant at $p<0.05$.The significant decrease was represented in percentages for different concentration respectively as follows: Total cholesterol (7.47%, 16.16%, 35.95%), triglyceride (4.95%, 7.69%, 15.93%), High Density Lipid (HDL) (60%, 22.85%,14.28%) as well as Low density lipid (LDL) (0%, 22.70%, 27.56%) when compared with the control, it also showed a significant result at $p <0.05$ for glucose level of normal rats and a reduction in body weight of the albino rats when the final body weight was compared with the initial due to the high fiber content of Gum Arabic. Gum Arabic as supplement in the diet should be done because it is rich in highly soluble fiber.

Key words: Gum Arabic, Diet, Supplementary, Albino Rats

INTRODUCTION

Gum Arabic (GA) is dietary fibre that is derived from dried exudates of *Acacia Senegal* [1]. It contains of high molecular weight (lipoprotein) and low molecular weight (heterogeneous gum polysaccharides). It is indicated that the supplementation with Gum Arabic increases faecal nitrogen excretion and lowers serum urea nitrogen concentration in chronic renal failure patients

consuming a low protein diet [2]. Increasing the ratio of the Gum Arabic (5- 15%) in the basal a layer's diet significantly reduced serum cholesterol in a gradual manner and consequently in egg where lower yolk cholesterol was observed by Sabahelkhier [3].Cholesterol, the most important sterol, is found only in food derived from animal sources such as egg yolk, liver and kidney. The body of human cannot breakdown the sterol nucleus, but it is either excreted unchanged in bile or converted to bile acids and then excreted. Bile acids and effective transformation in food composition, and to describe the physiological and biochemical mechanism of the effect of food fats on health welfare [4].

Gum arabic (GA, E-Number 414) is an edible, dried, gummy exudate from the stems and branches of Acacia Senegal and A. Seyal that is rich in non-viscous soluble fiber [5]. It is defined by the FAO/WHO Joint Expert Committee for Food Additives (JECFA) as 'a dried exudation obtained from the stems of A. senegal (L.) Will denow or closely related species of Acacia (family Leguminosae). In 1982 JECFA classified GA as 'ADI not specified'. However, as a result of subsequent research, the specifications for GA have been revised on several occasions [6,7,8]. GA has wide industrial uses as a stabilizer, thickening agent and emulsifier, mainly in the food industry (e.g. in soft drinks syrup, gummy candies and marshmallows), but also in the textile, pottery, lithography, cosmetics and pharmaceutical industries [9].

In folk medicine, GA has been reported to be used internally for the treatment of inflammation of the intestinal mucosa, and externally to cover inflamed surfaces [10]. Despite the fact that GA is widely used as a vehicle for drugs in experimental physiological and pharmacological experiments, and is assumed to be an ''inert" substance, some recent reports have claimed that GA possesses anti-oxidant, nephroprotectant and other effects [11, 10]. Clinically, it has been tried in patients with chronic renal failure,and it was claimed that it helps reduce urea and

creatinine plasma concentrations and reduces the need for dialysis from 3 to 2 timesper week [12].

MATERIALS AND METHODOLOGY

Experimental Design

Sixteen (16) male Albino rats were purchased from the Animal Unit University of Jos and were fed with normal feeds and drinking water. The rats were maintained under standard animal house conditions for nine (9) weeks of acclimatization. They were provided with diets (Growers mash, Grand cereal Nigeria) and water and Gum arabic. After nine (9) weeks, the rats were all weighed and each weighed about 150Kg and were grouped into four groups; four movable cages each labeled. After two weeks of induction, the rats were divided into four groups, each having four (4) rats.

Group 1: Normal control (this group was not feed for two weeks with Gum Arabic suspension).

Group 2: This group was administered with 200mg/kg body weightof Gum Arabic suspension orally.

Group 3: This group was administered 400mg/kg body weight of Gum Arabic suspension orally.

Group 4: This group was administered 600mg/kg body weigh tof Gum Arabic oral suspension.

All treatments were done once daily for two weeks. The cages were cleaned once in a week except if there is any contamination within the week to ensure that the health of the rats was well maintained.

Experimental Animals

The animals were monitored with care and all the experimental procedure with the animals was in accordance with the internationally accepted principles for laboratory animal use and the experimental protocols were duly approved by the ethical committee of Animal House of University of Jos, Nigeria.

Blood Sample Collection

At the end of two weeks of treatment, the rats were sacrificed and blood was collected from each rat in each of the five groups into clean dry plain tubes. The blood samples were then collected to the dry plain tubes labeled group 1 to 4 for identification. The blood was allowed to clot. The clotted blood samples were dislodged using automatic pipette, then the dislodged samples inside centrifuge tubes were centrifuged at 4000rpm for five (5) minutes using Bench top centrifuge (Model: MEDIHEL Medical, England). Then the serum was collected for further analysis.

Determination of Serum Total Cholesterol

Total cholesterol was determined by the method of Allain *et al* and Rieschlau *et al* [13,14] cholesterol determination. This entails the use of cholesterol oxidase following enzymatic saponification.

Assay Principle

The cholesterol is determined after enzymatic hydrolysis and oxidation. Cholesterol ester is first hydrolysed in the presence of cholesterol esterase to yield cholesterol and fatty acids. The cholesterol so formed is oxidized and converted to cholestene-3-one and hydrogen peroxide. This reaction is mediated by cholesterol oxidase. The hydrogen peroxide is further broken down by enzyme peroxidase to form water and oxygen molecule. The oxygen molecule then goes to

react with 4-aminoantipyrine in the presence of phenol to form a colour complex, quinoneimine which serves as an indicator.

$$\text{Cholesterol ester} + H_2O \xrightarrow{\text{Cholesterol esterase}} \text{Cholesterol} + \text{Fatty acids}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{Cholesteroloxidase}} \text{Cholestene-3-one} + H_2O_2$$

$$2H_2O_2 + \text{Phenol} + \text{4-aminoantipyrine} \xrightarrow{\text{peroxidase}} \text{Quinoneimine} + 4H_20$$

(Colour complex)

Determination of Serum Triglycerides

The serum triglyceride level was determined by the method of Allain *et al* and Rieschlau *et al* [13,14] triglyceride determination.

Glycerol and fatty acids were first formed by lipase action on the triglycerides. The glycerol is then phosphorylated by Adenosine-5-triphosphate (ATP) to yield Glycerol-3-Phosphate (G-3-P) and Adenosine-5-diphosphate (ADP) in a reaction catalysed by glycerol kinase.

$$\text{Triglycerides} + 3H_2O \xrightarrow{\text{Lipoprotein lipase (LPL)}} \text{Glycerol} + 3\text{RCOOH}$$

$$\text{Glycerol} + \text{ATP} \xrightarrow[Mg^{2+}]{\text{Glycerol kinase (GK)}} \text{G-3-P} + \text{ADP}$$

$$\text{G-3-P} + O_2 \xrightarrow{\text{Glycerylphosphate oxidase}} H_2O_2 + \text{DAP}$$

$$H_2O_2 + \text{4-aminoantipyrine} + \text{p-chlorophenol} \xrightarrow{\text{Peroxidase (POD)}}$$

$$\text{4-(p-benzoquinone-monoimino)-phenazone} + 2H_2O + HCl$$

Glycerol-3-phosphate is oxidized by the glycerylphosphate oxidase (GPO) producing dihydroxyacetonephosphate (DAP) and hydrogen peroxide (H_2O_2). The peroxide so formed

reacts with 4-aminoantipyrine and 4-chlorophenol (or p-chlorophenol) under the catalytic influence of peroxidase (POD) to yield quinoneimine, coloured complex.

Determination of High Density Lipoprotein (HDL) Cholesterol

Assay Principle

Low density lipoproteins are precipitated by the addition of phosphotungstic acid in the presence of Magnesium ions (Mg^{2+}). The HDL fraction remains in the supernatant and this is determined by cholesterol assay. The serum HDL Cholesterol was determined enzymatically according to Finley *et al* [15] method of HDL Cholesterol.

Determination of Low Density Lipoprotein (LDL) Cholesterol

Assay Principle

Low density lipoproteins are precipitated by the addition of heparin at their isoelectric point (pH 5.04). The HDL and VLDL remain in the supernatant and can be determined by enzymatic methods [13,14].

LDL Cholesterol = Total Cholesterol – Cholesterol in the supernatant.

Determination of Alanine Amino Transferase

Principle

$$\alpha\text{-ketoglutarate} + \text{L-alanine} \xrightleftharpoons{\text{ALT}} \text{L-glutamate} + \text{pyruvate}$$

$$\text{Pyruvate} + \text{NADH} + H^{+} \xrightleftharpoons{\text{LDH}} \text{L-lactate} + NAD^{+}$$

The rate of the photometrically determined NADH decrease is directly proportional to the rate of formation of pyruvate and thus the ALT activity [15].

Determination Aspartate Amino Transferase (AST) Test

Principle

α-ketoglutarate + L-aspartate $\underset{}{\overset{AST}{\rightleftharpoons}}$ L-glutamate + oxaloacetate

the enzyme AST catalyzes this equilibrium reaction. The increase in oxaloacetate is determined in an indicator reaction catalysed by malate dehydrogenase.

Oxaloacetate +NADH + H^{+} $\overset{MDH}{\rightleftharpoons}$ L-malate + NAD^{+}

NADH is oxidized to NAD. The rate of the photometrically determined NADH decrease is directly proportional to the rate of formation of oxaloacetate and thus the AST activity [15].

Determination of Alkaline Phosphatase (ALP) Test

Principle

In the presence of magnesium and zinc ion, P-nitrophenyl phosphate is cleaved by alkaline phosphatase into phosphate and P-nitrophenol. The P-nitrophenol released is proportional to the ALP activity and is measured spectrophotochemically [15].

Determination of Blood Glucose Level Using Strip Method

Principle and Intended Use

The on-call plus Blood Glucose Test Strip, with a chemical reagent work with the on-call plus and on-call EZ Blood Glucose Meters to measure the glucose concentration in whole blood. Blood is applied to the end tip of the test strip, and then automatically absorbed into the reaction cell where the reaction takes place. A transient electrical current is formed during the reaction and the blood glucose concentration is calculated based on the electrical current detected by the display plasma-like concentration results.

This is for *in vitro* diagnostic use. Test strips are to be used only outside the body for testing purposes and professional use.

RESULT

Table 1 Shows the effect of different concentration of Gum Arabic on Body Weight of Normal healthy rats. There was a decrease in body weight of Albino rats, this decrease was expressed in percntage when compared to the Normal control. In the Group treated with 200mg Gum Arabic, there was a percentage decrease by 11.77% when compared to the control likewise the groups feed 400mg and 600mg they showed a percentage decreases by 5.88% and 5.88% respectively when compared with the control.

Table 1 Effect of different concentration of Gum Arabic on body weight of normal Albino rats.

GROUPS	FINAL WEIGHT	INITIAL WEIGHT	WEIGHT LOSS
Normal	160	170	10
200mg	150	170	20
400mg	140	170	30
600mg	130	170	40

This table is showing the weight of experimemtanl rats before and after the star of the reseacrh.

In table 2, decrease in the enzmatic activity ALP of normal healthy albino rats treated with 200mg, 400mg and 600mg Gum Arabic. This decrease was statistically significant at $p<0.05$, this when expressed in percentage yeilded 14.74% for 200mg while that for 400mg is 17.88% and 600mg is 27.24% when each group was compared with the Normal control.

Likewise, the enzymatic activity of ALT and AST showed a significant increase at $p<0.05$ when compared to the normal control .

Tabble 2 Effect of different concentration of Gum Arabic on the Enzymatic activity of ALP, AST, and ALTof healthy Albino rats.

Groups	ALT	AST	ALP
Normal	14.0±0.005	23.0±0.005	35.9±0.011
200mg	25.0±0.011*	59.0±0.057*	30.61±0.005*

400mg	30.0±0.011*	76.0±0.005*	29.48±0.005*
600mg	35.0±0.011*	96.0±0.011*	26.12±0.011*

*Statistically significant from the control ($p<0.05$) using one-way ANOVA.

Table 3, shows the effect of different concentretion of Gum Arabic on rats with normal serum Glucose levels at different time intervals in hours. The result obtained was statistically significant at $p<0.05$. This increase was expressed in the percentagesat different time inteerval.

0hour, rats feed with 200mg showed a percentage increase by 40.48%, 400mg percentage increase is 17.95% and 600mg percentage increase is 39.82%.

½ hour, percentage increase for 200mg, 400mg, and 600mg was 29.29%, 12.74% and 43,32% respectively.

The percentage increase at the end of 1 hour is 7.79%, 2,71% and 16.91 respectively for 200mg, 400mg and 600mg.

At the end of 2 hours, the percentage increase for 200mg, 400mg, and 600mg was 20%, 10% and 14% respectively

Table 3: Effect of different concentration of Gum Arabic on Serum Glucose blood level of healthy Abino rats

GROUPS	**0HR**	**30MINS**	**1HR**	**2HRS**
Normal	50.30±0.333	52.33±0.667	51.6±0.333	50±0
200mg	70.66±0.333*	67.66±0.333*	55.62±0.333*	60±0*
400mg	59.33±0.667*	59.0±0*	53.0±0*	55±0*

600mg	70.33±0.333*	75.0±0*	60.33±0.333*	57±0*

*Statistically significant from the control ($p<0.05$) using one way ANOVA.

In table 4, shows a decrease in Total Cholesterol, Triglyceride, LDL and HDL when different concentration (200mg, 400mg, 600mg) of Gum Arabic was given to the Albino rats. This decrease was sentifically significant at $p<0.05$, the result obtained by one way avona was expressed in percentage for each of the parametersand the percentage diecrease was compared to the normal comtrol and it as follows for each parameter;

Total Cholesterol, had a percentage decrease of 7.47%, 16.16% ,35.95% for rats feed with 200mg, 400mg and 600mg Gum Arabic respectively when compared tothe control.

Triglyceride percentage decrease were 4.95%, 7.69% and 15.935 for 200mg, 400mg and 600mg respectively when compared to the control.

Low Density Lipoprotein(LDL) also had a precentage decrease of 0%, 22.70%, 27.56% respectively for 200mg, 400mg,and 600mg respectively.

High Density Lipoprotein showed a precentage decrease of 60%, 22.85%, and 14.28% respectively for 200mg, 400mg and 600mg respectively.

Table 4: Effect of different concentration of Gum Arabic on Serum Lipid Profile.

GROUPS	**TC**	**TG**	**HDL**	**LDL**
Normal	4.95±0.028	1.82±0.005	0.35±0.023	1.85±0.001
200mg	4.58±0.017*	1.73±0.005*	0.56±0.011*	1.85±0.005*
400mg	4.15±0.015*	1.68±0.003*	0.43±0.011*	1.43±0.014*

600mg	3.17±0.012*	1.53±0.011*	0.40±0.005*	1.34±0.005*

*Statistically significant from the control ($p<0.05$) using one-way ANOVA.

DISCUSSION

Table 1, there was significant decrease in body weight of the rats which could be due to alteration in biochemical activity of the rats which caused significant changes in the body weight after the administration of gum arabic.

In table 2, the result shows a decrease in body weight of the albino rats. This finding was in Line with the result obtained by Martin [16]. This is because dietary fibre may be able to displace available calories and nutrients and it increases the efficiency of absorption in the small intestine Slavin, [17] and also weight loss is due to loss of appetite caused by the ingestion of gum Arabic Martin, [16].

In table 3, the results showed a decrease in ALP and an increase in AST and ALT when compared with the control rats and rats feed with oral dose of different concentration of Gum Arabic. As the dose of the Gum Arabic increased ,the values of ALT ,AST increased while that of ALP increased which might be due to low levels of Total Cholesterol and Triglyceride. Therefore,high Enzyme Activity cases a fast rate of Triglyceride and Cholesterol break down in the bile .

In table 3, the results showed a increase in glucose level of normal albino rats . Gum Arabic is highly water soluble and has a low viscosity and hence unlikely to modify glucose absorption.

Therefore, Gum Arabic has the ability to reduce glucose level in rats with normal glucose levels but not in glucose induced rats.

In table 4, the results showed that Total cholesterol level when compared with the control rats, it showed a lowering effect at different concentration of oral dose of Gum Arabic. This finding was in line with the results obtained by Alasdair *et al*. [18] found that gum arabic decreased the serum cholesterol level. Kishimoto *et al*. [19] showed that a Prevotellaruminicola-like bacterium was the predominant organism that is most likely responsible for fermentation of GA to propionate. Propionate could limit the induction of key enzymes of cholesterol metabolism hence lowers cholesterol levels [20, 21].

A decrease in triglyceride levels was obtained at different concentration of oral dose of Gum Arabic when compared to the control. Thisresult was in line with that obtained by Topping *et al*. [22] serum triacylglycerols were significantly lower.

Low Density Lipoprotein (LDL) was in contrast to Davidson [23] because he said that fibres have three properties that aid them in reducing LDL levels in the serum which include solubility in water, fermentability and viscosity. Gum Arabic is water soluble but has low viscosity hence lacks the ability to reduce LDL concentration in serum.

CONCLUSION

Cholesterol is an important substance that our bodies generate. Cholesterol is a waxy, soft material that is observed about the lipids of bloodstream and in cells. Good cholesterol is important for cell membrane formation, hormones and other functions. Nonetheless, when

cholesterol level gets too high due to the fact of the foods that compose diets, it outcomes in a problem called hypercholesterolemia. Cholesterol either LDL or HDL. LDL, i.e. low-density lipoprotein is the harmful cholesterol. HDL, i.e. high-density lipoprotein is the helpful cholesterol. Our health is improved when we minimize our LDL level and increase our HDL level. An elevated LDL cholesterol level can result in heart disease which kills a third of us and requires 10-15 years off our average life-span. High blood levels of cholesterol and triglycerides can lead to arteriosclerosis, i.e. hardening of the arteries that results in less blood flow and so much less oxygen for our cells and tissues. If arteriosclerosis develops close to our heart, it puts us at risk for a heart attack. If arteriosclerosis develops close to our head and neck, we are at risk for a stroke. Arteriosclerosis leads to high blood pressure simply because the walls of our arteries are lined with cholesterol creating the passage for our blood flow smaller and even blocked which demands our heart to pump blood with more force in order for our blood to circulate.

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