



Faculty of Specific Education

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Effect of galangal (*Alpinia galangal*) as consumption as antioxidants on hyperlipidemic and hyperglycemic (In experimental rats)

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Thesis

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Summary

The utilization of medicinal plants and preparations derived from as dietary supplements and functional foods. Therefore, it is important to evaluate the adverse effects of those plants and their preparations to increase the confidence in safety to human. There are about 6000 plants which are reported to possess hypoglycemic, antioxidants, anticancer and antidiabetic activities (**Sharma et al., 2015**). Galangal (Family–*Zingiberaceae*) has been widely cultivated in India, Malaysia, Indonesia, Egypt and Saudi Arabia (**Trakranringgsie et al., 2014**). Galangal is rich in phenolic compounds such as flavonoids and phenolic acids (**Pahwa et al., 2016**). Rhizomes are lowest in fat but richest in carbohydrate. Antioxidant effects, antidiabetic and many other nutritional effects. This study includes chemical analysis antioxidant contents as polyphenols, flavonoids, carotenoids, saponins and tannins. Phenolic compounds such as flavonoids and polyphenols, also alloxan rats fed on basal diet content different concentration of (100 ppm, 200 ppm water extracts), (100 ppm, 200 ppm ethanol extracts) and (5%, 10% powder

rhizome). Previous studies have demonstrated an anticancer effect of the galangal such as liver cancer (HEPG2-H), breast cancer (MCF-7) and blood cancer cells (HCT). The anticancer activity of ethanol extract of galangal has been examined against two cancer cell lines represents blood cancer, breast cancer and hepatic cancer (HCT, MCF7-H and HEPG2-H, respectively).

For these reasons this investigation was directed to the following point:

Part (I): Chemical composition

- The chemical composition of rhizomes was determined on dry matter. The protein, moisture and ash amounted to (3.44 g/100g), (10.5 g/100g) and (2.04 g/100g) respectively. While, crude fiber, crude fat and total carbohydrate were contents (14.6 g/100g), (1.14 g/100g) and (68.28 g/100g).
- Dietary fiber consisted of soluble dietary fiber (SDF) fraction (Pectin), while the insoluble dietary fiber (IDF) fraction contained cellulose. The values of SDF and IDF were 16.30 g/100g and

9.46 g/100g respectively. It could be observed that SDF (pectin) exceeded that of IDF (cellulose) on rhizome of galangal.

- The chemical analysis antioxidant contents as polyphenols, flavonoids, carotenoids, saponins and tannins. Phenolic compounds such as flavonoids and polyphenols were include galangin, quercetin, kaemferol, kaemferide and syringic.
- Tannins contents were higher than saponins in powder rhizome.
- concentration of various minerals in galangal rhizome, the rhizome was rich in elements on dry weight basis (mg/100g) such as copper (Cu), zinc (Zn), selenium (Se), magnesium (Mg), Iron (Fe), chrome (Cr), potassium (K), sodium (Na) and calcium (Ca).
- The solubility of elements in dried rhizome had high antioxidants and biological activities. Generally, rhizome was playing important roles as hypoglycemic, hypocholesterolemic and antioxidant agents.

Part (II): Antioxidant contents (polyphenols and flavonoids)

- Polyphenols can decrease your risk of heart disease. Polyphenols may also have anticancer effects in certain population subgroups, though the data supporting this is inconclusive. There is also some indication that polyphenols may help prevent dementia, osteoporosis and diabetes, though research results are shown galangal rich polyphenols.
- Data reveal that both polyphenols and flavonoids contents were relatively high in ethanol extracts (70%) from rhizome of galangal contained relatively high amount of polyphenols like Syringic acid (206.8654 mg/100g), Pyrogallol (200.8499mg/100g), Benzoic acid (29.5381mg/100g), and Protocatechuic acid (27.6671 mg/100g). On the other hand the results are recorded that E-Vanillic acid (10.7806 mg/100g), Epicatechin (9.3616 mg/100g), Caffeic acid (6.0719 mg/100g), Chlorogenic acid (5.9447 mg/100g) and Ferulic acid (4.6468mg/100g).

- Flavonoids are powerful antioxidants with anti-inflammatory and immune system benefits. Diets rich in flavonoid-containing foods are sometimes associated with cancer, neurodegenerative and cardiovascular disease prevention. Flavonoids include quercetin and kaempferol, they are found in galangal.
- Flavonoids rocket that contained high amounts of Hisperdin (10.1404 mg/100g), Rutin (5.0467 mg/100g), Naringin (4.6759 mg/100g), 7-OH flavones (1.1446 mg/100g), Narengenin (1.0957 mg/100g) and Kampherol (0.9814 mg/100g), and recorded that contained Apegenin (0.4623mg/100g), Hespertin (0.4613 mg/100g), Quercetrin (0.4003mg/100g), Rosmarinic (0.2982 mg/100g), and Quarcetrinin (0.1457 mg/100g).

Part (iii) hypoglycemic and hypolipidemicactivites:

- An experiment was carried out on rats in order to evaluate the biological value of powdered rhizome, water extracts and ethanolic extracts as hypoglycemic and hypocholesterolemic agents.

- Rats (48 animals) were fed on a basal diet for two weeks, and then they were divided into two groups. The first group was fed on a basal diet for another six weeks (normal control). The second group (42 rats) was injected by alloxan solution to induce hyperglycemia and hypercholesterolemia. The diabetic group was divided into seven groups. The first group was continued to be fed on a basal diet (diabetic control). Other groups (6) were fed on different concentration which was contained 5% or 10% powdered rhizome, water extracts (100 and 200 ppm) and ethanol extracts (100 and 200 ppm).
- No significant increase in liver, kidney, lung, heart and spleen weight either in rats fed on dried rhizome or on ethanol extracts and water extracts when compared with diabetic control or normal control.
- It was observed that, the begin weight showed no significant differences among all six studied groups. At the end of experimental period, the rats fed on basal diet which suffering from hyperglycemic group was highly decrease significant change in body weight gain when compared with hyperglycemic group.

- Feeding by rhizome (10%) was decrease body weight gain, even significant differences were observed in comparison to hyper group.
- Hypercholesterolemic rats that were fed on different concentration of ethanol, water extracted and powder of rhizome showed sharply significant decrease in serum total cholesterol group.
- These study were recorded in the hyper cholesterolemic rats that fed on water extract 200ppm (65 ± 2.35 mg/ml)and showed similar decrease significant in serum total cholesterol with rats fed on ethanol 200 ppm (59.60 ± 4.51 mg/ml) and powder rhizome 10%(55.80 ± 2.59 mg/ml).
- Concerning of serum total triglycerides, the highly significant decrease during the experimental rats was recorded (80.80 ± 7.76 mg/ml) for the group which fed on the diet containing on rhizome 5%, the group which fed on the diet containing water extracts 100 ppm (102.40 ± 7.44 mg/ml) that no significant decrease compared with hyper group.

- The groups had fed on powder rhizome (5%) showed sharply decrease at experimental compared with positive control which recorded that (22.00 ± 2.67 mg/ml), also powder rhizome (10%) showed sharply decrease on serum HDL which recorded (21.60 ± 2.30 mg/ml). Generally, the group had fed on rhizome (10%) showed decrease on serum HDL compared with other concentrations.
- All hypercholesterolemic rats fed on different concentration of powder rhizome extracts showed sharply decrease in serum LDL in comparison to the positive control groups.
- Hypoglycemic activity of galangal rhizome and its extracts in rats the investigation was carried out to study effects of galangal rhizome on serum glucose levels. In normal rats, powdered rhizome and ethanol extract of galangal was found to be effective on serum glucose levels. The administration of powdered rhizome of galangal to the normal rats produced significant decrease in serum glucose level.

Part (IV): Biological investigation:

- An experiment was carried out on rats in order to evaluate the biological value of galangal ethanolic extracts, galangal water extracts and powder of rhizome as hypoglycemic and hypocholesterolemic agents.
- Rats were fed on a basal diet for two weeks, then they were divided into two groups. The first group was fed on a basal diet for another six weeks (normal control). The second group (42 rats) was injected by alloxan solution to induce hyperglycemia and hypercholesterolemia. The first subgroup was continued to be fed on a basal diet (diabetic control). Other subgroups (36) were fed on different diets which were contained (5% and 10% rhizome powder), (100ppm and 200ppm water extracts) and other groups fed on (100pm and 200ppm ethanol extracts).
- Rats of diabetic control lost their body weight at higher rate compared with rats fed on rhizome 5% and 10% of diet.
- No significant increase in liver, kidney, lung, heart and spleen weight either in rats fed on rhizome or on their water extracts and

ethanol extracts when compared with diabetic control or normal control.

- The serum glucose level was determined 72h after alloxan injection and it was found to be raised to an average value ranged from 184.80 to 278.20 mg/ml in all groups. Generally, glucose levels reduced after two weeks and consistent till the end of the six weeks.
- In case of rats fed on diets containing 10% rhizome, 5% rhizome and 200ppm ethanol extract the serum glucose level decreased significantly to 88.20 ± 7.19 , 97.80 ± 8.41 and 97.84 ± 11.78 mg/ml, respectively at the end of experiment.
- Glucose levels decreased after six weeks by 97.80 ± 8.41 mg/ml in rats which were given 5% extracts from rhizome and serum glucose level was significantly decreased in rats given 10% rhizome which recorded 88.20 ± 7.19 mg/ml.
- Increments in serum total lipids, triglycerides and total cholesterol in case of diabetic control compared with normal control.

- The level of serum total lipids, triglycerides and total cholesterol significantly decreased in rats fed on diets containing 10% rhizome, 5%rhizome and 200ppm ethanol extracts.
- Substantially, positive control group (hyper cholesterolemic rats) had highly significant increase in serum total cholesterol comparison with healthy rats negative control group which fed on basal diet and recorded (67.40 ± 3.58 mg/ml).
- All hyper cholesterolemic rats that were fed on different concentration of ethanol, water extracted and powder of rhizome showed sharply significant decrease in serum total cholesterolemic group.
- The best results in these study were recorded in the hyper cholesterolemic rats that fed on water extract 200ppm (65 ± 2.35 mg/ml) and showed similar decrease significant in serum total cholesterol with rats fed on ethanol 200 ppm (59.60 ± 4.51 mg/ml) and powder rhizome 10%(55.80 ± 2.59 mg/ml). Moreover, hyper cholesterolemic rats fed on water extracts tended to have

serum total cholesterol lower than other groups. On the other hand these groups showed decrease significant when compared with positive groups.

- Positive control group (hyper cholesterolemic rats) had highly significant increase in serum total triglycerides and recorded (230.60 ± 3.72 mg/ml) comparison to healthy rats (negative control group) which fed on basal diet that recorded (75.80 ± 11.17 mg/ml).
- Concerning of serum total triglycerides, the highly significant decrease during the experimental rats was recorded (80.80 ± 7.76 mg/ml) for the group which fed on the diet containing on rhizome 10%, the group which fed on the diet containing water extracts 100 ppm (102.40 ± 7.44 mg/ml) that no significant decrease compared with hyper group. On the other hand the low decrease during the experimental rats was recorded (76.60 ± 4.34 mg/ml) for the group which fed on the diet containing ethanol extracts 200 ppm.
- The group had fed on rhizome (10%) showed decrease on serum HDL compared with other concentrations.

- Groups rat which fed on water extract 200 ppm recorded (14.40 ± 1.34 mg/ml) and ethanol extract 200 ppm recorded (19.20 ± 2.17 mg/ml) showed significant decrease at all study compared with positive group.
- The groups had fed on powder rhizome (5%) showed sharply decrease at experimental compared with positive control which recorded that (22.00 ± 2.67 mg/ml), also powder rhizome (10%) showed sharply decrease on serum HDL which recorded (21.60 ± 2.30 mg/ml). Generally, the group had fed on rhizome (10%) showed decrease on serum HDL compared with other concentrations.
- Data regarding LDL of serum positive control has been highly increase significant at $p < 0.05$ in comparison with negative (healthy rats) control recording (64.80 ± 10.55 mg/ml) and (11.00 ± 4.47 mg/ml) respectively.
- All hypercholesterolemic rats fed on different concentration of powder rhizome extracts showed sharply decrease in serum LDL in comparison to the positive control groups. That mean, the diet

containing extract of galangal may help in treatment of LDL and decrease its values.

- The best results were recorded in the group rats fed on rhizome 10% recorded (14.60 ± 2.61 mg/ml) significantly decrease more than negative control (healthy rats).
- In high fat diets induced the infected hyper lipidemic rat's model, feeding with the atherogenic diet for 30 days were significantly increased the plasma levels of STG, TC, LDL-C, LDL/HDL, TC/HDL ratios. They tested the effect of serum lipids, oxidative stress and high fat diet induced hyperlipidemic rat models resulted in a significant reduction in serum total cholesterol (STC), triglyceride (TG) and lipid peroxide levels ($p < 0.05$).

Part (V) : Anticancer Activities:

- The SRB analysis carried out in the cancer of liver (HEPG-2H), breast cancer cells (MCF-7) and blood cancer cells (HCT) revealed that the ethanol extract of galangal could effectively reduce the growth and multiplication of the tumor cells.
- The anticancer effect was varied according to the type of cell line as well as LC50. As for the cytotoxic effect of galangal on breast

cancer in the form of (MCF7–H) data revealed that with increasing the extract concentration, the cytotoxic effect was increased and it recorded LC50 64 µg/ml.

- The hepatic cancer in the form of HEPG2–H cell line exhibited more resistance for extract and this was appeared clearly in the value of LC50 which recorded 117µg/ml.
- The blood cancer in the form of (HCT) cell line exhibited more resistance for extract and this was appeared clearly in the value of LC50 which recorded 85µg/ml.

Part (VI) Galangal in food applications:

Dried glangal can use as flavoring agent in Egyptian traditional and familiar dishes as tomato puree (Ketchup), potato puree, Egg plant puree (Papa ghnogh).