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HYPOGLYCEMIC ACTION OF *ZINGIBER OFFICINALE ROSCOE*

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Abstract.- Oral administration of clear aqueous extract from 2 g of ginger root/animal to fasting rabbits showed 16% lower blood sugar level compared to control administration. Improved oral glucose tolerance was shown when the animals were orally administered with the aqueous ginger extract. Glucose tolerance test did not show significant improvement following administration of aqueous suspenssion of ginger material as compared to control study, supposedly due to interference of starch material's presence in the administratered material. Ginger constituents extracted in lipid solvent improved glucose tolerance as well as showed hypoglycemia in the fasting animals but could not compare to results of aqueous extracted constituents from ginger. Presence of hypoglycemic constituents of lipid as well as other nature are reported from the study.

INTRODUCTION

Certain natural products of plants origin, used as spices food and folk medicine since ancient times, are being investigated recently to provide scientific basis for their medicinal use. Among these most noted are onion and garlic for their hypolipidemic and inhibitory effect on atherosclerosis (Bordia *et al*., 1975; Kritchevsky *et al*., 1980 and Chi *et al*., 1982).

Ginger obtained as rhizome from *Zingiber officinale* is recognized as an important folk medicine in many parts of the world. Several pharmacological actions concerning gastrointestinal tract, respiratory tract and neuropsychological system have been stated in the literature of folk medicine (Nadkarni, 1958). It has been claimed that ginger juice is a good remedy for diabetes of both types i.e. mellitus and inspidus. Ginger contains about 3 to 7% ethereal oils, the principal constituents of which are three sesqueterpenes: bisabolene, zingerberene and gingerberol. The pungency of the material is due to ginger oleresins mainly zingerone and shogaol. Thus its active constituents mostly are of lipid nature.

The present study is undertaken to evaluate the effect of ginger, obtained as extract in the different forms, on blood glucose level and utilization of glucose after oral infusion from the blood i.e. Glucose Tolerance Test (G.T.T.).

MATERIALS AND METHODS

Adult male rabbits weighing about one kg were used in the study. They were fasted for 12 hours prior to their use in each experiment. They were fed on green fodder and soaked chick pea, the green fodder was provided *ad libitum*.

Three preparations of ginger were employed for the administration. For crude aqueous, suspension weighed ginger was crushed to obtain colloidal suspension in a required amount of tap water. Aqueous extracts was prepared by letting the particals to settle down in the suspension and separating the clear supernatent. Lipid extracted constituents of the rhizome were obtained by crushing ginger thoroughly in Folch solvenet (chloroform methanol 2:1). The crushed suspension was filtered and clear filtrate was evaporated and residual material was suspended in tap water.

The ginger preparations and the glucose solution (0.2 gm/ml) were administered by tube feeding to the maximum of 25 ml per administration for an animal. The same animal was used in control and experimental study of an experiment. Control part of the experiment was performed earlier and experimental part after a gap of one day. Same animal was not used for at least ten days in between the two experiments.

Repeated blood sampling was performed from the peripheral ear vein of the rabbit. Blood sugar was determined by ortho-toludine in glacial acetic acid mathod (Cheesbrough, 1981).

RESULTS

Twenty ml of clear aqueous extract prepared from 2 g of ginger root was administered per animal in the treatment phase of the experiment. In a comparative control phase of the experiment, performed earlier, animals were administered with 20 ml of tap water per animal. In control phase fasting blood sugar level was 99.6±1.7 mg %, which altered as 99.9±2.5, 96.0±1.96, 94.2±2.1 and 91.6±1.9 mg %, ½, 1,2 and 4th hourly respectively after the adminisration of tap water. Here the maximum variation from fasting blood sugar level observed was about 8% decrease. In the experimental phase fasting, blood sugar level was 97.8±3.7 mg%, it varied as 91.6±6.5, 83.3±9.0, 74.6±7.5 and 81.9±2.8 mg %, ½, 1, 2 and 4th respectively after ginger extract administration. The maximum variation in this phase was a decrease of 16.2%. Thus significant lowering of blood sugar was observed after ginger extract administration as compared to the control observations (Fig. 1).

Oral glucose tolerance test (OGTT) was performed after ginger extract administration and compared with controls. Fasting animals, soon after a fasting blood sampling, were fed with ginger extract in the dose utilized in earlier experiment. Half an hour after this 5.0 gm of glucose in 25 ml sloution was tube fed and ½, 1, 1-½, 2, 3 and 4 hours after glucose administration blood samples

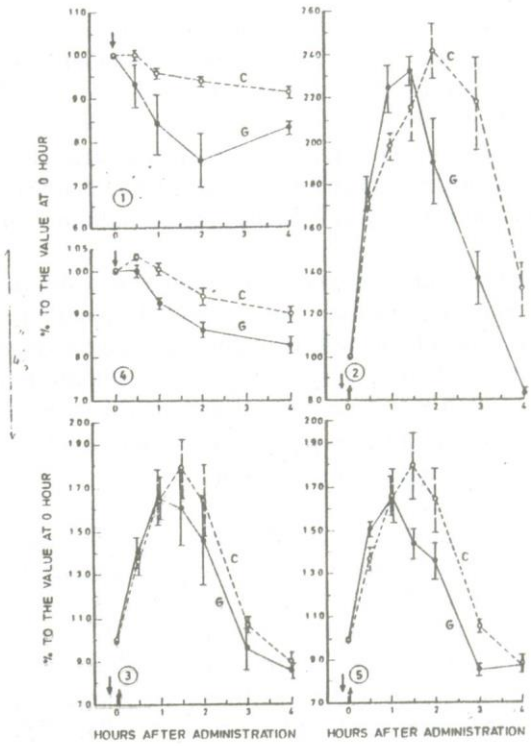

Fig. 1. Analysis of glycemia in aqueous ginger extract administered (G) and control animals (C). ↓ Clear aqueous extract from 2 g ginger.

Fig. 2. Analysis of OGTT in the aqueous ginger extract administered (G) and control animals (C). ↑ 5 g glucose administered orally, ginger administration half hr before glucose loading.

Fig. 3. Analysis of OGTT in aqueous ginger suspension administered (G) and control animals (C). ↓ 2 g aqueous ginger suspension half hr before glucose loading. ↑ 5 g glucose administered orally.

Fig. 4. Analysis of glycemia following administration of lipid extracted constituents of ginger (G) and compared with controls (C): ↓ Lipid extracted constituents from 2 g ginger.

Fig. 5. Analysis of OGTT following lipid extracted constituents of ginger administration (G) and compared with controls (C). ↑ 5 g glucose administered orally, ↓ ginger administration half hr before glucose loading.

were obtained for blood glucose level determination. A similar control experiment, except where 20 ml of tap water was administered in place of ginger extract, was performed. In the control experiment, standardizing the fasting blood sugar level as 100 its level ranged as 170.9±3.8, 197.7±6.7, 241.9±17.4, 241.5±12.6, 217.0±19.3 and 131.6±12.9, % at ½, 1, 1½, 2, 3 and 4 hours respectively after glucose loading. However after ginger administration the comparative observations were 176.0±8, 244.0±11.6, 231.7±7.5, 189.6±21.1, 135.9±12.4 and 81.8±3.2% at same timings respectively after glucose administration.

A significantly improved glucose tolerance was shown after ginger root administration as compared to the controls. (Fig. 2). Another similar experiment was performed after the administration of aqueous suspension of ginger instead of clear supernatant as used earlier. In this experiment slightly improved response of glucose tolerance was shown in the animal with ginger suspension administration as compared to controls Fig. 3. But it was poor when compared with the experiment of aqueous extract administration.

Dried lipid extracted material of ginger root was suspended in tap water and administered orally at the dose as employed in the aqueous preparation. In an experiment average fasting blood glucose level was 97.7±3.3. mg % which ranged 100.1±3.42, 97.5±4.5, 91.9±5.1 and 87.9±4.7 mg%, ½, 1, 2, and 4th hr. respectively after tap water administration for control studies. Here the maximum variation from fasting blood sugar level was 9.3%. In the experimental phase fasting blood sugar level was 93.3±2.5 mg % which later ranged at 94.1±2.9, 86.6±2.1, 80.7±2.7 and 77.8±3.8 mg% at the same time intervals after lipid extracted ginger constituents administration. Here the maximum variation in this phase was a decrease at 17.0%. Comparatively greater decrease was obtained after ginger extract administration as compared to the control observation (Fig. 4).

In the experiment of OGTT following lipid extracted ginger constituents, an improved tolerance compared to control observations was found. This tolerance almost compared with the result of experiment with aqueous extract, although 4 hours observations following respective administrations indicate that maximum improvement was found after clear aqueous extract administration (Fig. 5).

DISCUSSION

The different experiments performed had shown that ginger root possesses certain constituents which have the characteristic of lowering blood sugar level following their administration.

In a fasting group of the animals almost 16% lowering of blood sugar level occured 2 hrs after ginger administration as compared to their control observations (Fig. 1).

The presence of blood sugar lowering constituents is made evident with the experiments of OGTT following ginger root administration. Here, improved glucose tolerance indicated the presence of certain active substances in the root which enhance utilization of blood sugar. An interesting phenomenon was observed that the faster assimilation of glucose occured in the experiments with ginger administration as compared to the control. The rehabilitation of normal sugar level in these experiments with OGTT was quicker in comparison to the control state of the animals.

Results with the administration of crude aqueous suspension of ginger root are not as significant as with clear aqueous extract, this perhaps is due to the inclusion of starch material in crude aqueous suspension which interfered with the sensitivity following its digestion, assimilation and appearance in the blood. Ginger contains about 50% of starch.

Considering that active constituents may mainly be of lipid nature as its active constituents are ethereal oils and resins, the ginger was extracted in lipid solvent and extract was used in experiment. The result of lipid extracted constituents were found resembling with the experiments done with clear aqueous extract. However proportionally lower improvement in the glucose tolerance was shown when compared to clear aqueous extract infusion. This indicates that all the blood sugar lowering constituents are not extracted in the lipid solvent.

This assumption also co-relates to the studies done by Gilberto (1942) and Ahmad (1986) on the hypoglycemic effects of *Momordica charantia*. Khanna (1981) is also certain that the plant *Momordica charanctia* has hypoglycemic mode of action and a polypeptide "p" responsible was isolated from the plant. In our present study certain such constituents are not only of lipid nature but also seem to belong to water soluble fraction. There is no doubt that lipid extract constituents did show blood sugar lowering character also. The mode of action of the ginger constituents may be pancreatic-tropic, through enhanced stimulation of β-cell as in sulfonylureas, or extrapancreatic. Certain natural plants products have been reported to cause lowering of blood sugar without the involvement of pancreas. (Leatherdale *et al*., 1981). The confirmation of such a mode of action shall require further experimentation. Nevertheless, hypoglycemic activity in the ginger root extract has been clearly demonstrated.

REFERENCES

AHMAD, M.M., NAHID, K., HAFEEZ, M.A. AND QURESHI, J.A., 1986. Improvement in GTT by *Gymneva sylnestre, Rubus ulmifolius* and *Momordica charantia. Pakistan J. Zool.*, **18**: 89-97.

BORDIA, A., ARORA, S.K., KOTHARI, L.K., JAIN, R.C., RATHORE, B.S., RATHORE, A.S., DUBE, M.K. AND BHU, N., 1975. The protective action of essential oils of onion and garlic in cholesterol fed rabbits. *Atherosclerosis*, **22**: 103-110.

CHEESBROUGH, A. *Medical laboratory manual for tropical countries*. Stephen Austen and Sons Ltd, Hertsford.

CHI,. M.S., KOH, E.T. AND STEWART, T.J., 1982. Effect of garlic on lipid metabolism in rats fed cholesterol or lard. *J. Nutr.*, **112**: 241-248.

GILBERTO, A.T. AND RIVERO, S.A., 1942. A study of hypoglycaemic activity of *Momordica charantia. Amer. J. Pharm.*, **114**: 72-87.

KHANNA, P., JAIN, S.G., PANAGARIYA, A. AND DIXIT, V.P., 1981. Hypoglycaemic activity of polypeptide "P" from a plant source. *J. Nat. Prod.*, **440**: 648-665.

KRITCHEVSKY, D., TEPPER, S.A., MORRISEY, R. AND KLURFELD, D., 1980. Influence of garlic oil on cholesterol metabolism in rats. *Nutr. Rep.*, **22**: 641-645.

LEATHERDALE, A., PANESAR, R.K., SINGH, G., ATKINS, T.W., BAILY, C.J. AND BIGNELL, A.H., 1981. Improvement in glucose tolerance due to *Momordica charantia* (Karela). *Brit. Med. J.*, **282**: 1823-1824.

NADKARNI, K.M., 1958. *Indian Meteria Medica* (revised and enlarged by A.K. Nadkarni) Vol. I, p. 1300 Dhootapapeshwar Prakashan Ltd., Bombay.