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Effect of *Zingiber officinale* (ginger) on human haemostatic parameters

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Abstract

Ginger (*Zingiber officinale)* is a widely used food spice in many countries. It has been used for treating several health conditions in traditional Chinese medicine. Several literatures have outlined the antiplatelet activity of ginger (*Zingiber officinale*) with little scientific data to support this claim. This study was carried out to determine the effect of ginger on human haemostatic parameters. Prothrombin Time (PT), Partial Thromboplastin Time with Kaolin (PTTK), platelet count and whole blood clotting time were carried out on eighty samples with ginger extract as test sample, while thirty samples without ginger extract as control samples. It was observed that only the PT and PTTK were significantly affected ($p < 0.001$). While the platelet count and whole blood clotting time were not statistically affected ($p > 0.05$) by the addition of ginger extract.

Keywords: Haematology, Coagulation, Haemostasis, Ginger, Prothrombin

1 Introduction

Blood clotting is a host defense mechanism that in collaboration with the inflammatory responses helps to protect the integrity of the vascular system and promotes repair when there is a tissue damage or injury. There are series of orderly steps that incorporate parts of the vasculature, platelets and coagulation proteins which will lead to the formation of platelet plug and also stable fibrin clot [1]. When soluble fibrinogen is converted into insoluble fibrin forming a clot, the aim of the coagulation cascade is achieved [2]. Haemostasis occurs via three main steps in a rapid inter dependent manner; constriction of the blood vessels take place which reduces blood loss and this is known as vascular spasm. Followed by this is the formation of a temporary platelet plug by sticking of platelets together covering the break in wall of blood vessels. The third step is the coagulation or blood clotting stage. Coagulation reinforces the platelet plug with fibrin threads that act as a "molecular glue" [3]. Platelets are an important factor to the entire hemostatic process. They allow for the creation of the "platelet plug" that forms almost directly after a blood vessel has been ruptured. Platelets begin to adhere to the sub endothelium surface immediately there is a disruption to the blood vessels epithelial wall. The formation of the first fibrin strands has been estimated to occur within sixty seconds. Formation of a complete platelet plug by fibrin takes place after several minutes [4].

One of the most common food spices around the world is Ginger. Although it is native to tropical Asia, cultivations in tropical regions of India, Jamaica, Australia, West Africa, some parts of the United States have been reported in several literatures [5]. It is cultivated in many parts of Northern Nigeria and used all over the country for preparation of several local recipes and dishes and also in treating some ailments locally. In Chinese medicine, ginger rhizome has a long history of use as an anti-inflammatory, antipyretic and antiemetic agent [6].

The root (rhizome) is the therapeutic components of ginger. Gingerols found in ginger's oleo-resin are one of the major active constituents. These compounds have been reported to possess the following properties: antitussive, antipyretic, analgesic and a good sedative. When gingerol is dehydrated, the shogaol homologues are obtained. One of these products, 6-shogaol and galanolactone are thought to act on serotonin (5-HT) receptors. Ginger's volatile oils contain active components which can be used for topical application. Major constituents are beta-bisabolene and zingiberene. Other compounds in the oils include zingiberol, zingiberenol, ar-curcumene, beta-sesquiphellandrene, beta-sesquiphellandrol. Also found are numerous monoterpene hydrocarbons, alcohols and aldehydes [7].

Several literatures have pointed out antiplatelet activity of ginger with little available scientific investigations as evidence, hence the need to carry out a scientific investigation on the effect of ginger on human haemostatic parameters *in vitro* as it applies to our locality.

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2 Materials and methods

2.1 Collection of blood samples

Blood sample (12 mL) was obtained from the antecubital vein of each subject using sterile needle and syringe. 5 mL of the sample was placed in potassium EDTA sample bottle for platelet count, 2 mL of sample into clean glass test tube for whole blood clotting time and 4.5 mL of sample into container containing 0.5 mL of trisodium citrate to prevent the clotting process. Centrifugation was then carried out on the samples in trisodium citrate sample bottles to separate the blood cells from plasma in order to obtain pure platelet plasma for PT and PTTK test. Each plasma sample was separately dispensed into plain container using automatic pipette and stored at the appropriate temperature and analysis was carried out.

2.2 Testing using ginger extract

Zingiber officinale rhizomes was purchased commercially in local market. The skin was peeled and washed in water, it was sliced into little chunks and oven dried at 60 °C for 24 hr. The dry rhizomes were ground into fine powder. Ten grams of the powder was weighed using sensitive balance and suspended in 100 mL of distilled water in a conical flask with continuous shaking for twenty four hours for proper dissolution. The supernatant of the extract was filtered using filter paper. The final aqueous extract (10%) of *Zingiber officinale* was used for an in vitro testing of its possible anticoagulant activity in blood samples of apparently healthy individuals using the principles of prothrombin time test (PT) and Activated Partial Thromboplastin Time (PTTK), whole blood clotting time and Platelet count [3].
For determination of the Prothrombin time (PT) and Partial Thromboplastin time with Kaolin (PTTK), the citrated plasma samples of test subjects were used. **PT:** 100 µL of the aqueous ginger extract was added to plasma samples of the test subject and subsequent testing of PT was carried out by adding 100 µL of sample with aqueous ginger extract to a clean dry test tube in water bath, 100 µL of thromboplastin reagent (Helena Biosciences, UK) was added using an automatic pipette and time taken for clot formation was determined using a stopwatch. The same procedure was repeated for control samples without the addition of ginger extract [8]. **PTTK:** 100 µL of test sample with ginger extract was added to test tube in water bath, 100 µL of APTT reagent was dispensed and allowed to incubate for ten minutes. 100 µL of calcium chloride was added with gentle shaking in water bath and the time taken for clot formation was determined using a stopwatch. The control samples were analysed following same procedure without the addition of ginger extract [8].

2.3 Platelet count

Manual platelet count was done on control samples without ginger extract while 100 µL of aqueous ginger extract was added to test samples and platelet count was carried out using 1:20 dilution of whole blood to ammonium oxalate counted using improved Neubauer counting chamber [9].

2.4 Whole blood clotting time

For whole blood clotting time, 2 mL of control subjects' sample was dispensed into a clean glass test tube directly from syringe after sample collection while 100 µL of aqueous ginger extract was added to test tube before addition of test subjects' sample. The whole blood clotting time was ascertained [9].

2.5 Statistical analysis

Statistical analysis was done by T-test ($p < 0.05$ was considered statistically significant) using SPSS (version 20) statistical software.

3 Results

Table 1 shows a comparison of the measured variables between the whole blood clotting, platelet count, prothrombin time, partial thromboplastin time with kaolin of subjects sample and their respective controls.

Table 1. Comparison of measured variables between subjects with *Zingiber officinale* extract (test) and control subjects without *Z. officinale* extract (Mean ± SEM).

Parameters	Control subjects (n = 30)	Test subjects (n = 80)	p value
Clotting Time (minutes)	6.7 ± 0.367	7.28 ± 0.268	0.317
Platelet Count (x 10^9/L)	220 ± 20.5	230 ± 10.7	0.692
Prothrombin Time (seconds)	13.4 ± 0.34	23.8 ± 0.755	< 0.001
Partial Thromboplastin Time with Koalin (seconds)	42 ± 0.907	62.3 ± 1.14	< 0.001

The platelet count of subjects were found to be non-statistically significant ($p > 0.05$) after *in vitro* assay with *Zingiber officinale* extract, the mean platelet count was found to be 230 ± 10.7 and the control was 220 ± 20.5. The mean whole blood clotting time of subject samples was 7.28 ± 0.268 while that of the control subjects was 6.7 ± 0.367. This showed no statistical significance ($p > 0.05$).
Prothrombin time were found to be statistically very siginificant ($p < 0.001$) after in vitro assay with *Zingiber officinale* extract. The mean prothrombin time was found to be 23.8 ± 0.755 while the control subjects had a prothrombin time average value of 13.4 ± 0.34. Also, partial thromboplastin time with kaolin of subjects in comparison with that of the subjects showed a statistical significance with ($p < 0.001$). The mean PTTK value was 62.3 ± 1.14 while that of the control was found to be 42 + 0.907.

4 Discussion

This study was conducted to determine the invitro effect of *Zingiber officinale* on haemostatic parameters in humans. Results obtained showed that out of the four parameters examined (whole blood clotting time, platelet count, prothrombin time and partial thromboplastin time with kaolin), only the prothrombin time and partial thromboplastin time with kaolin showed appreciable level of significance when statistically examined ($p < 0.001$). This maybe due to the inhibitory efffect of gingerol; an active *Zingiber officinale* constituent on the coagualtion cascade supposedly inhibiting factor V which is needed in both the intrinsic and extrinsic coagulation pathways in addition to other factors inhibited . However, further studies are required to identify the role of gingerol on blood clotting. The platelet count and whole blood clotting time did not show reasonable statistical significance ($p > 0.05$).

The prolonged prothrombin time was in agreement with a prevoiusly published study on *Zingiber Officinale,* [3] reported that *Zingiber officinale* caused a prolonged prothrombin time and the findings were limited to just the prothrombin time and no report on the partial thromboplastin time.

It has therefore been established from the results obtained from this research that *Z. officinale* also inhibits and prolongs the partial thrombopastin time which showed that both the intrinsic, extrinsic and common pathways of the coagulation cascade are affected by *Z. officinale.*

It was observed that the platelet count showed no statistical significance on analysis in comparison with that of the control subjects ($p > 0.05$) and this showed compliance with the findings of Lumb et al. [10], who reported that *Z. officinale* showed no effect on platelet count but contrary to the report of Nurtjahja-Tjendraputra, et al. [11], that *Zingiber officinale* had antiplatelet activity.

Also, the whole blood clotting time was not significantly affected in comparison with that of the control. Lumb et al. reported no effect of *Zingiber officinale* on clotting time of his research samples [10].

Therefore, *Zingiber officinale* can be said to have some effect on the haemostatic parameters in humans. This can exacerbate haemorrhagic episodes in those predisposed to haemostatic disorders.

5 Conclusion

The observed results in this study reveals that Prothrombin Time (PT), Partial Thromboplastin Time with Kaolin (PTTK) were significantly afftected by the effect of aqeuos ginger extract while platelet count, whole blood clotting time were not affected. Further research are recommended to find out the viability of ginger in management of some haemostatic disorders such as disseminated intravascular coagulation.

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Conflict of interest

The authors have no conflict of interest to declare.

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