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Investigation the phytochemical profiling and therapeutic evaluation of ginger root powder against hypercholesterolemia and obesity

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Abstract: Obesity is a metabolic disease that is characterized by increased caloric intake and decreased physical activity. Ginger (*Zingiber officinale*) is used as a spice that has potential role as an alternative medicine in a range of many diseases. The current research was carried out to explore the anti-obesity potential of ginger root powder. For this, the chemical and phytochemical characterization of ginger root powder were analyzed. Results showed that it contains moisture, ash content, crude fat, crude protein, crude fiber, and nitrogen free extract 6.22±0.35, 6.37±0.18, 5.31±0.46, 1.37±0.15, 10.48±0.67 and 64.78±11.33 mg /dl, respectively. Furthermore, the ginger root powder was given in the form of capsules to obese patients for the already designed treatment groups. The experimental groups (G_1 and G_2) were given ginger root powder capsules (3g) to G_1 group and (6g) was given to G_2 group for the time of 60 days. Results unveiled that G2 group showed highly significant change on waist to hip ratio (WHR) and the other parameters like (BMI, Body weight) and cholesterol showed slightly - significant change on both groups G1 and G2. It can be considered as an arsenal for fight against the health problems that have been raised from the obesity.

Keywords: Obesity, ginger powder, antioxidant, human health, nutrition.

INTRODUCTION

Obesity is a major health problem because there is an imbalance between energy intake and expenditure, which leads to an excessive amount of energy being stored as triglycerides in adipose tissue. The prevalence of obesity is frighteningly increasing throughout the world. Data from the World Health Organization (WHO) show that of the two billion or so overweight persons globally, one third are obese. (Tanzil and Jamali, 2016). Genetic, environmental, behavioral and cultural factors can all interact in complex ways to cause it. On the other hand, obesity has numerous other detrimental health effects that can result in conditions like hyperlipidemia, hypertension, type 2 diabetes and cardiovascular diseases, among many others (Tanzil and Jamali, 2016). Obesity is also related to hyperlipidemia which is based on the biochemical changes in the blood i.e. distributed lipid metabolism and increased concentration of lipids in the blood (Mahmoud *et al*., 2013; Attari *et al*., 2017).

The alarming rise in obesity and unwelcome weight gain over the previous 20 years had raised concerns on a global scale. In comparison to men, women in all age categories have a larger burden of obesity. In 2015, there were 38.4% overweight and 14.3% obese women over the age of 20, compared to 27.9% overweight and 14.4% obese men (Chooi *et al*., 2019). Obesity is on the rise in Pakistan, impacting people of all ages (Asif *et al*., 2020). In the Peshawar district, abdominal obesity affects more women than men, and a good anthropometric indicator of abdominal obesity is waist circumference. Out of the total study population, there were 2080 abdominally obese people (or 55.82%) and 1646 non-abdominally obese people (or 44.17%). 62.48% of the participants in our study did not exercise. In our study population, male and female abdominal obesity rates were 31.54% and 51.26%, respectively (Ahmed *et al*., 2018).

Nowadays, the trend of using synthetic supplements for reducing obesity is increasing alarmingly. The use of natural materials has been considered an effective tool for obesity control. The anti-obesity supplements have adverse harmful effects and are costly to use. Although anti-obesity medications have some short-term benefits, their high costs, the possibility of drug abuse, the possibility of weight gain after stopping use and other side effects are significant barriers to use. Ginger is a monocotyledon belonging to the family *Zingiberacea*.

The type of name ‘Zingiber’ is derived from the Sanskrit vocabulary and means ‘trumpet’ to indicate the bulb’s bulging growth. Ginger (*Zingiber officinale*) is generally known as ginger and belongs to ginger family. Ginger oil consists of monoterpenes (Attari *et al*., 2015).

Ginger *(Zingiber officinale)* has been developed for medical and cooking purposes for at least two countries. It

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contains hundreds of valuable compounds and still finds new ingredients. The percentage of ginger samples in each country depends on the country of origins, the commercial processor and the type of ginger. The active ingredient of ginger mainly plays its role in gingerol and its related dehydrated products as well as volatile oils. Ginger can be a more cost-effective drug for treating diseases such as CVD.

There are various factors that could account for the potential link between ginger consumption and body weight. The impact on stomach motility and discharge rate is the first mechanism (association with appetite and energy intake). The association between thermogenic properties and energy consumption is the second mechanism. The stimulation of gastric motility and discharge is thought to produce the first effect. According to earlier research, ginger shortens the half-discharge duration and speeds up antral contraction. In fact, ginger is available as a supplement for metabolic disorders such as obesity. Interleukin-6 (IL-6) and tumour necrosis factor mRNA levels can be considerably downregulated by ginger extract and gingerol, according to research (de Lima *et al*., 2018).

The powdered rhizomes of *Zingiber officinale*, commonly known as ginger, are eaten either fresh or dried. Ginger powder has a higher antioxidant, flavonoid, and phenolic capacity than raw ginger. The polyphenol compounds (6-gingerol and its derivatives) found in its roots and obtained extracts have a high antioxidant activity. The goal of the current study was to assess the effectiveness of ginger in preventing obesity while concentrating on sensory and proximate evaluation of capsules containing ginger powder.

MATERIALS AND METHODS

Collection and preparation of raw material

Ginger (*Zingiber officinale*) were collected from the local market and cleaned to get rid of the debris, dust and foreign objects stuck to the surface. Following washing, the ginger was dried at room temperature to make fine powdered with the help of grinder and stored in airtight polyethene bags (Maharlouei *et al.,* 2018). Ginger root powder was identified for various features and following major characters were measured prior to further development.

Characterization of ginger root powder

Chemical analysis of ginger (Zingiber officinale) powder

Ginger (*Zingiber Officinale)* dried root powder were analyzed for the following proximate profile as ash, moisture, carbohydrates, crude protein, crude fiber and nitrogen free extract (NFE) according to the reported official methods AOAC (2006).

Minerals determination

The following minerals zinc, magnesium, iron, phosphorus, potassium, sodium and copper were analyzed by using atomic absorption spectrometry (Latona *et al*., 2012).

Phytochemical analysis

The ginger powder was subjected to antioxidant analysis for determination of total phenolic and total flavonoids content (Li and Parry, 2011).

Nutritional assessment

The nutritional assessment like height, weight, BMI, and anthropometric measurements like (waist to hip ratio and hip ratio) were also measured (Kumari and Gupta, 2016).

Ethical approval

The authors declared that there is no ethical issues in this paper.

STATISTICAL ANALYSIS

To determine the level of significance, Steel *et al*. (1997) described statistical analysis using Statistix 8.1 and one – way (ANOVA) Software Analysis of Variance Technique under a Completely Randomized Design (CRD) on results from various studies.

RESULTS

Proximate analysis

The quality of the raw materials being used is significantly influenced by the determination of proximate composition. Z. Officinale dry powder was examined for a number of quality characteristics, including (moisture, ash, fiber, proteins, fat, and carbohydrate alongside nitrogen free extract). Complete components of proximal analysis are comprised of these six quality criteria. The findings show that the moisture content of ginger powder is 6.22 0.35. The ginger powder sample's ash content was 6.37 0.18, while the amounts of protein, fat, fiber, and nitrogen-free extracts were 5.31 0.46, 1.37 0.15, 10.48 0.67 and 64.78 11.33 mg/dl, respectively.

Table 1: Proximate Composition (%) of *Z. officinale* root powder

Proximate Parameters	Composition
Moisture	6.22±0.31
Ash content	6.37±0.14
Crude Protein	5.31±0.44
Crude fat	1.37±0.11
Crude fiber	10.48±0.64
NFE	

Mineral analysis

In the current investigation, the minerals zinc (Zn), manganese (Mn), copper (Cu), calcium (Ca), iron (Fe), sodium (Na), phosphorus (P) and potassium (K) were found in the powdered ginger rhizome. The mineral composition findings are consistent with a previous study on a few species of medicinal plants, which identified potassium as the major element. It was stated that the recommended daily intake of vital minerals should be greater than 50mg. The body's extra cellular and intracellular processes depend on vital minerals like calcium and phosphorus, which also serve as the building blocks for the body's structural elements. Even at a threshold level, minerals like iron can work as antioxidants and contribute to boosting the immune system. While zinc is known to prevent bleeding disorders, growth retardation, cardiomyopathy and muscle deterioration. These minerals can therefore be used in food applications thanks to the ginger root's presence of these minerals.

Table 2: Mineral composition of ginger root powder

Minerals	Composition (ug/g)
Zinc (Zn)	4.14±0.03
Manganese (Mn)	16.32±1.48
Copper (Co)	0.78±0.01
Calcium (Ca)	32.45±1.21
Phosphorus (P)	24.59±1.47
Iron (Fe)	1.47±0.04
Potassium (K)	36.48±1.81

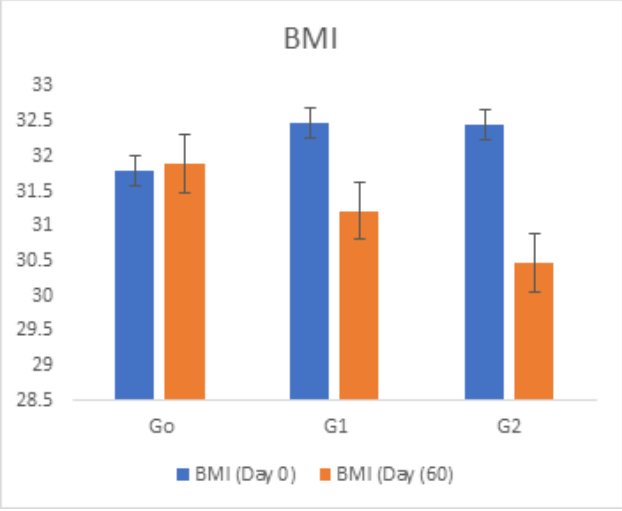

Fig. 1: BMI values for different groups

Phytochemical analysis of ginger root powder

Phenolic chemicals, which are significant plant components, have redox properties that control their antioxidant action. The hydroxyl groups in plant extracts are what facilitate free radical scavenging. The methanolic extract's higher phenolic content is what gives it its bioactivity; therefore, it is reasonable to predict that it will perform well in terms of antioxidant and anti-hyperlipidemic and anti-obesity properties for the management of weight. The ginger powder was subjected to TPC and TFC analysis. The ginger powder contains a significant amount of TPC and TFC depicted in table 3.

Table 3: Phytochemical analysis of ginger powder

Antioxidant	Antioxidant content
TFC	94.48 mg CE/g db
TPC	112.47 mg GAE/g db

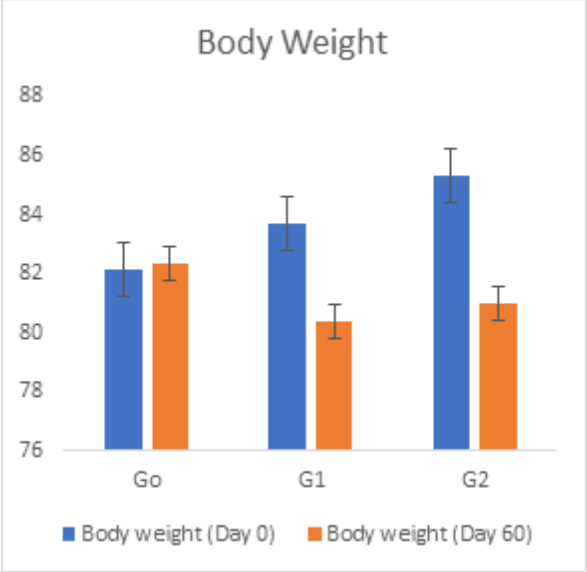

Fig. 2: Body weight of different groups

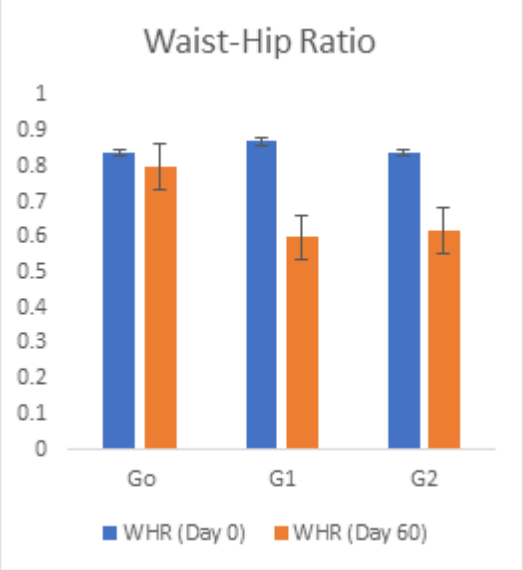

Fig. 3: WHR of different age groups

Bio-evaluation of ginger root powder against obesity

The purpose of this efficacy study was to shed light on the benefits of Z. officinale dried powder as a supplement for treating obesity in humans. It was suggested that the human test subjects adhere to some dietary

recommendations. Following the inclusion and exclusion criteria, a 2-month efficacy study was conducted on obese females with their consent. However, slightly BMI reduction was recorded in G2 (32.45±2.13 to 30.47±2.31) and then in G1 (32.47±2.13. to 31.22±2.24). G2 demonstrated lower mean BMI reduction; to 32.45±2.13 to 30.47±2.31 respectively. As, the control group's result remained same 32.90±2.27 to 32.7±2.54. Result obtained from G1 and G2 were approximately similar and both groups decreased BMI to a minimum level (fig. 1).

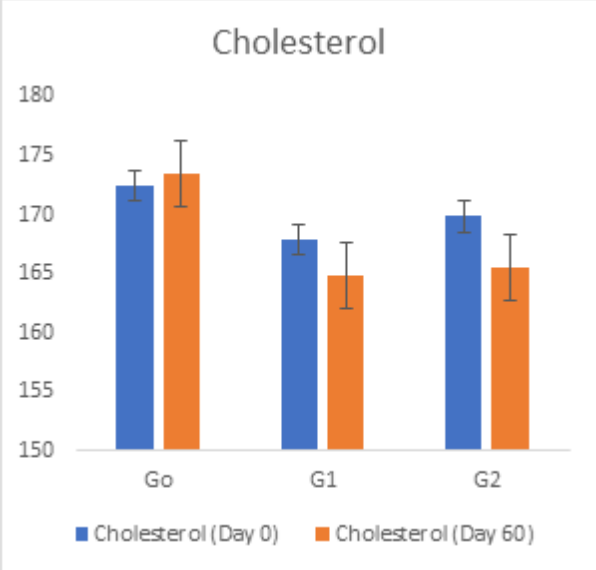

Fig. 4: Cholesterol level for obese patients

Bodyweight of different groups

According to mean table there were considerable change was witnessed in both G1 and G2; 83.67±5.33 to 80.500± 5.47 and 85.300±5.25 to 80.980±4.47 respectively. The values for G0 group remained same from (82.120±4.42 to 82.340±4.03). This leads to the conclusion that in G0, G1, G2, shows that that G2 was most successful in attenuating the body weight in human subject. (fig. 2)

WHR of different groups

The mean for waist to hip ratio (WHR) contents shows highly significant results. However, the increase was lowest for G0 group from 0.84±0.05 to 0.80±0.07. Whereas the waist to hip ratio decreased d from 0.87± 0.05 to 0.60±0.08 in G1 group.

In G2 maximum escalation in waist to hip ratio was observed from 0.85±0.05 to 0.53±0.04. This suggests that *Z. officinale* improves the content of waist to hip ratio (WHR) in obese volunteers. (fig. 3)

Cholesterol level for obese patients

It is apparent from the means of table 2 that minimum 1 % cholesterol drop was recorded in G0 group from 172.45±25.39 to 173.52±25.29. According to statistical results, the cholesterol shows non- significant changes but both G1 and G2 showed approximately some prominent decrease in cholesterol values; 2.7% and 4.2% respectively. G2 diminished cholesterol numeric value from 169.85±26.37 to 165.45±26.51 and in G1 it was decreased from 167.9±26.35 to 164.78±26.70 respectively. (fig. 4)

DISCUSSION

The plant family Zingiberaceae includes ginger (*Zingiber officinale* Roscoe). Since ancient times, it has been used to cure conditions like arthritis, stomach distress, asthma, diabetes, and menstrual irregularities in Asia, India, Europe, and the Middle East. There is scientific proof that ginger may reduce nausea and vomiting caused by pregnancy, surgery, cancer treatment, or motion sickness, as well as hints that ginger may lessen pain and inflammation.

Especially in Asia, the plant ginger (*Zingiber officinale* R.) is well-known and well-liked. It has positive impacts on health and contains several intriguing bioactive substances. The antioxidant properties of methanol extracts from the leaves, stems and rhizomes of two *Zingiber officinale* plants were investigated to assess and validate the therapeutic potential of the young ginger's underground portion. Previous research has demonstrated that several flavonoids, including quercetin, have anticancer properties and can slow the growth of cancer cells.

After supplementing obese females with *Z. officinale* for 60 days, Attari *et al*. (2015) evaluated the impact on parameters related to obesity and discovered that the supplementation group had significant improvements in body weight, BMI, cholesterol and WHR.

An approximate analysis revealed that there is a significant amount of moisture, fat, ash, and crude protein in ginger powder. Similarly, mineral analysis and phytochemical showed ginger powder contain significant level of iron, zinc, potassium, copper, calcium, phosphorous and total phenolic and total flavonoids content.

Gallic acid has been demonstrated to be a free radical scavenger, an inducer of differentiation and death in lymphocyte cell lines from leukemia, lung cancer, and colon adenocarcinoma as well as from healthy lymphocytes. Like quercetin, it has been hypothesized that GA is crucial in preventing cancer development and malignant transformation.

CONCLUSION

Results unveiled that G2 group showed highly significant change on waist to hip ratio (WHR) and the other parameters like (BMI, Body weight) and cholesterol

showed slightly - significant change on both groups G1 and G2. Hence, it can be considered as an arsenal for fight against the health problems that have been raised from the obesity.

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