INTRODUCTION

Aflatoxin is a secondary metabolite of certain strains of Aspergillus flavus and Aspergillus parasiticus that have been shown to be toxigenic, carcinogenic, mutagenic, and teratogenic to different species of animals (Hoffmann et al., 2015). Aflatoxin has been detected in cereal grains, whole wheat and rye bread, oilseeds, fermented beverages made from grains, milk, cheese, meat, nut products, fruit juices, and numerous other agricultural commodities (John, 2015). Therefore, the presence of Aflatoxin or toxigenic fungi in foods presents a potential hazard to human and animal health. Human epidemiology and experimental animal studies have provided the statistical association and biological information necessary to suggest that Aflatoxin are risk factors for human liver cancer (IARC, 2012), its activated by cytochrome P450 to form Aflatoxin B1-8,9-epoxide, which is responsible for the mutagenic activity. Aflatoxin B1-8,9-epoxide specifically binds to the N7 position of guanine of DNA and RNA to form Aflatoxin B1-N7-guanine adduct (Voth-Gaeddert et al., 2018). Aflatoxin B1 inhibits DNA, RNA, and protein synthesis, resulting in immuno-suppressive, hormonal and teratogenic effects (Aiko and Mehta, 2015).

Ginger (Zingiber officinale) is a flowering plant whose rhizome, ginger root or simply ginger, is widely used as a spice or a folk medicine, it’s a herbaceous perennial which grows annual pseudostems (false stems made of the rolled bases of leaves) about a meter tall bearing narrow leaf blades. Ginger is in the family Zingiberaceae, to which also belong turmeric (Curcuma longa), cardamom (Elettaria cardamomum), and galangal (An et al., 2016). Ginger is renowned for its multiple medicinal uses. Ancient Hawaiian
medicine recommends ginger to relieve a headache, toothache, achy joints, and stomachache as well as various other maladies (Wen et al., 2014). Modern herbal medicine uses ginger primarily to treat motion sickness, however, its anti-inflammatory properties can also help to treat migraine headaches, rheumatic and muscular disorders, arthritis, and other inflammation-related ailments and it’s a potentially very effective phytomedicine in treating a wide variety of illnesses (Chinese Pharmacopoeia, 2010).

**MATERIAL AND METHODS**

**Chemicals**
All chemicals were purchased from Sigma company and the standard Aflatoxin B1 (AFB1) purchased from Santa Cruz (USA).

**Animals and Experimental Design**
A total forty albino BALB/C male mice average weight (30±5g) were used. Animals were caged randomly allocated into four experimental groups and given water and fed wheat. The first group of 10 mice was (Control) were fed on uncontaminated wheat; the second group of 10 mice served as the treated group were fed contaminated wheat with 35μg/ kg body weight AFB1 for 5 weeks served as positive control, the third group of 10 mice was fed on ginger root extract alone (30ml/kg body weight) and the fourth group of 10 mice was fed on a mix of ginger root extract and contaminated wheat with 35μg/ kg body weight AFB1 for 5 weeks. At the end of the experimental period, the mice were sacrificed. Blood samples were collected in sterile plastic test EDTA tube and serum samples were separated and used for analysis of biochemical parameters.

**Extraction of Ginger Root Extract (GRE):**
Ginger root (Zingiber officinale) were obtained from Baghdad markets and the extraction was performed (Angeli et al., 2014). Ginger samples were ground using an electric blender, weighed, and mixed with a solvent, and extracted by 70% ethanol in conical flasks sealed with foil and put on a magnetic stirrer for 7 days. Then, they were filtered to obtained crude extracts. The extract was then placed into open Petri dishes in an incubator at 40°C until dryness. All extract was stored at -18°C when they not use.

**Serum Analysis**
All biochemical parameters for liver function: Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST) and Gamma-glutamyl transpeptidase (GGT) were determined with the blood autoanalyzer Mindray BC-2800 (Germany) using kits (DPC, Diagnostic Products Corporation, USA) in Al- Yarmouk hospital.

**Histological Examination**
Liver processing and staining depending on (Luna, 1968).

**RESULTS**

**Biochemical Results**

**Serum levels of Alanine aminotransferase activity (ALT):**
The mean serum activity level of (ALT) in treated group on which the mice fed on AFB1 contaminated wheat (79.01± 1.05 IU/L), where significantly higher (P ≤ 0.05) than control mice (27.15 ± 1.12 IU/L). When ginger root extract used with AFB1, the ginger root extract could significantly lower the serum activity level of ALT to reach (38.10± 1.01 IU/L), but significantly higher than that of control group, while the serum activity level of ALT in mice treated with ginger root extract alone reach to (28.34± 1.00 IU/L) (Figure 1).

**Serum levels of Aspartate Aminotransferase (AST):**
There was a significant change in the mean serum level of (AST) in the AFB1 group (199± 1.15 IU/L) when compared to that of a control group (75.03± 1.05 IU/L). The ginger root extract with AFB1 group has been recorded also a significant difference in the mean serum level of (AST) (94.96± 1.22 IU/L) when compared to that of a control group and AFB1 group, while the ginger root extract recorded about (77.61± 0.98 IU/L) (Figure 2).

**Serum levels of Gamma-glutamyl transpeptidase (GGT):**
There was a significant difference in the mean serum level of (GGT) in the AFB1 group (27.19±0.97 IU/L) in comparison with that of a control group (12.14±1.01 IU/L). Ginger root extract plus AFB1 group showed no significant difference in the mean serum level of (GGT) (15.08±1.21 IU/L) into that of a control group, but mean serum level of (GGT) in mice treated with ginger root extract alone reached to (12.09± 1.03 IU/L) (Figure 3).

![Figure 1: Mean serum level of ALT in experimental mice groups](image-url)
**Histopathological Result of Liver**

Investigation of liver microscopic sections for a control group showed normal tissue (Figure 4). While mice treated with AFB1 contaminated wheat showed injury in the liver due to toxicity by showing enlargement of hepatocytes and infiltration of mononuclear cells in and around congested blood vessels with apoptotic and mitotic figures of hepatocyte (Figure 5). The mice fed on ginger root extract with AFB1 showed less to mild signs (Figure 6).

**DISCUSSION**

The liver is considered to be the principal target organ for Aflatoxin. The activity of ALT and AST are sensitive indicators of acute hepatic necrosis. In the present study demonstrated that the treatment with ginger root extract effectively protected the mice against AFB1 induced hepatotoxicity, as evidenced by decreased AST, ALT and GGT levels. These protective effects of ginger root extract against AFB1 induced hepatotoxicity were also confirmed by histopathological investigation. Increased in transaminases...
(ALT, AST, and GGT) were considered as an indicative for changes in the hepatic tissues (Abdel-Wahhab and Aly, 2005), reflected hepatocellular damages and as a sensitive indicator of chronic hepatic necrosis, also these results clearly indicated that AFB1 has stressful effects on the hepatic tissues (Shaji and Harish, 2014).

Ginger is a potentially very effective phytomedicine in treating a wide variety of illnesses and it’s not only an important spice but also a traditional Chinese medicine. Firstly, ginger has been used since antiquity as food additives for the purpose of flavoring. Mehrim et al. (2006) indicated that ginger was the best detoxifying agent of Aflatoxin using 0.5% ginger as dietary additives to alleviate the toxic effects of AFB1 contaminated fish diets.

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CONFLICT OF INTEREST

None of the authors have any conflict of interest to declare.

AUTHORS CONTRIBUTION

Dalia Abdul-Kareem Abdul-Shaheed: Plan of work, serum biochemical parameters analysis, statistical analysis, and manuscript preparation.

Oday Sattar Abbas: Plan of work, execution, histopathological technique, and manuscript preparation.

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