An *in Vitro* Antifungal and Antiaflatoxigenic Properties of *Commiphora myrrha* and *Prunus mahaleb*

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Abstract

Aflatoxins and especially aflatoxin B, are the devastating contaminant of food and feed products with hazardous effects to mankind and his domestic animals. These investigations were set to evaluate the effect of various levels of *Commiphora myrrha* resin (1.0, 1.25, 2.25, and 3.25 g/100 ml) and *Prunus mahaleb* seed extract (0.75, 1.5, 2.5, and 3.5 g/100 ml) on the growth and aflatoxin secretion by two aflatoxigenic strains of *Aspergillus flavus* and *A. parasiticus*. The two plant extracts significantly (p<0.05) decreased aflatoxin secretion, and inhibited the fungal growth. Resin of *C. myrrha* displayed 51.9-95.7% reduction in total aflatoxin secretion by *A. flavus*, and 46.9-92% for *A. parasiticus*, and Seed extract of *P. mahaleb* decreased aflatoxin up to 53.7-95.8% and 40-94.7%, respectively. The inhibition of aflatoxin B (B<sub>1</sub> and B<sub>2</sub>) by myrrh resin and seed extract of mahaleb ranged between 51.7-93.5, 50-93.6% (*A. flavus*) and 39.5-89.7%, 37.9-93% (*A. parasiticus*). The mycelial dry weight of *A. flavus* and *A. parasiticus* was decreased up to 46.1-58.7%, 28.9-51.3% (*Myrrh* resin), and between 45-56.9%, 33.3-55.9% (*Mahaleb* seed extract). Nonetheless, the two plant extracts did not detoxify aflatoxin B<sub>1</sub>. Therefore, it apparent that the resin of *C. myrrha* and seed extract of *P. mahaleb* affected the biosynthesis pathway of aflatoxins. Thus, they can be recommended as effective natural plant biopreservative against aflatoxin contamination of food and feed products.  

Keywords: Aflatoxigenic, *Aspergillus flavus*, *A. parasiticus*, *Commiphora myrrha*, *Prunus mahaleb*

1. Introduction

*Commiphora myrrha* (Nees Engl. (syn. *C. molmol*), myrrh (Mor Hijazi, in Arabic) of the family Burseraceae, is small tree or large shrub which found in dry and arid regions of Ethiopia, Somalia, North Kenya, North Africa, and Middle East (Abd-Ulgadir et al., 2015; Ali, 2007; Omer et al., 2011; Su et al., 2011). Myrrh gum-resin is the dried resinous exudate from plant stem of different *Commiphora* species. *C. myrrha* has various traditional uses in food and drink as flavoring, perfumes, and as fragrance in other cosmetics (Ali, 2007; Marshall, 2004). The natural gums are of high biocompatibility, available at low cost, low toxicity, and eco-friendly compared to the synthetic ones (Yusuf and Usman, 2011). Medicinally, myrrh gum has been extensively used for treatment of various diseases (El Ashry et al., 2003; Shen and Lou, 2008), rheumatic complaints, tooth decay, gum disease, and helminth infection (Abd-Ulgadir et al., 2015; Haffor et al., 2010), antiseptic, carminative, anti-inflammatory, and tonic in dyspepsia (Omer et al., 2011; Su et al., 2012). It exhibited numerous biological activities as anti-inflammatory, antibacterial, antifungal, antimicrobial, antioxidant, hepatoprotective, smooth muscles relaxing, antimalarial, anticaudial, antischistosomal, larvicidal, molluscicidal, anticancer, and hypolipidemic effect (Al-Abdallal, 2013; Al-Daihan et al., 2013; Ali et al., 2008; Dolar et al., 2000; Gadir et al., 2014; Shen et al., 2012; Shulan et al., 2011). Its antimicrobial activity, food preservation, pharmaceuticals, alternative medicine and natural therapies has been reported by many authors (Abd-Ulgadir et al., 2015). Antimicrobial activity against gram-positive organisms, *Candida albicans*, and other microorganisms was observed (Al-Daihan et al., 2015).
Prunus mahaleb L. (sync. Cerasus mahaleb L. Mill.) of the family Rosaceae is known as English cherry, Rock cherry, St. Lucie cherry and “mahleb, mahaleb, mahlab” in Arabic which grown abundantly in West Asia, North Africa, Middle East, and sometimes found in Eastern and Central Europe (Leri et al., 2012; Özcelik and Koca, 2012; Seyyednejad et al., 2008; Shams and Schmidt, 2007). Various products from seed kernels and fruits of mahaleb tree have many uses as pleasing spice in patisseries mixed with flour for their special fragrance, home baking and candy industry (Özcelik and Koca, 2012). It has been used in folk medicine in various ailments as tonic for sensory organs, heart diseases, asthma, blood pressure, diabetes, swelling of stomach, relieving pains arising from liver, kidney swelling, anti-kidney stones, inflammation, oxidative stress diseases, gastrointestinal problem, diarrhea, and for scenting and preservation purposes (Gerardi et al., 2010; Oskoueian et al., 2012; Shams et al., 2007). These plants are of significant potential in therapeutic applications against human pathogens including bacteria, fungi, and viruses (Holetz et al., 2002; Perez, 2003; Syyednejad, 2008). All methanol extracts from different parts of mahaleb including flowers, leaves, branches, fruits, fruit stalks, seed and seed coat showed antibacterial and antifungal activities (Özcelik and Koca, 2012). The ethanolic extracts of mahaleb had antibacterial activity against Proteus mirabilis, Bacillus anthracis, and Staphylococcus aureus (Seyyednejad et al., 2008).

Plant and animal products are prone to infestation with various mycotoxins producers molds (El-Nagerabi et al., 2012, 2013; Herzallah 2009; Salim and Ahmad 2010; Wagacha and Muthomi, 2008). Of these mycotoxins, aflatoxins are the most hazardous contaminants associated with adverse effects on health (Kumar et al., 2008). They are the most devastating pathogens of various crops and milks (Abdulkadir et al., 2004; El-Nagerabi et al., 2012; Elshafie et al., 2002; Payne 1998; Santacrose et al., 2008). Aflatoxin B1 is mutagenic, teratogenic and carcinogenic secondary metabolites of Aspergillus flavus, A. parasiticus, A. niger and A. pseudotamorii (El-Nagerabi et al., 2013; Sidhu et al., 2009).

Different plant extracts inhibit the fungal growth and aflatoxins production by A. flavus and A. parasiticus which suggest their antifungal and antiaflatoxigenic activities (El-Nagerabi et al., 2012). Many plants were examined such as Hibiscus sabdariffa (Al-Shayeb and Mabroom, 1984; El-Nagerabi et al., 2012), herbals (Gowda et al., 2004), and Garcinia cowa and G. pendunculata fruits (Joseph et al., 2005), Syzygium aromaticum, Cucum a longa, Allium sativum, and Ocimum sanctum (Reddy et al., 2009). Essential oils from anise, caraway, cinnamon, black cinum, fennel plants, and Negella sativa displayed similar effects (Bullerman et al., 1977; El-Nagerabi et al., 2012; Farag et al., 1989; Hasan, 1994; Maraga et al., 2007; Montes-Belmont and Carvajal, 1998; Patkar et al., 1993; Soher, 1999; Soliman and Badeea, 2002). Investigations using different extracts from Acacia seyal, Boswellia sacra, Balanites aegyptiaca, Moringa stenopetala, Tamaridus indica, and Adansonia digitata revealed different inhibitory effects on aflatoxin secretion by antiaflatoxigenic fungi (El-Nagerabi et al., 2012, 2013, 2016).

Different detoxification procedures have been tested for their inhibitory effect on the fungal growth and aflatoxin production (El-Nagerabi et al., 2016; Oguz, 2011). Numerous chemicals and physical factors were evaluated for their decontamination properties (Kumar et al., 2009). Nonetheless, safety issues and undesirable impacts on humans, animals and their environment restricted their use in food industries (Szczersbanik et al., 2007; Vijayanandraj et al., 2014). On the other hand, the biological detoxification of aflatoxin using different microorganisms was attempted by many authors (e.g. El-Nezami et al., 1998; Shantha, 1999). Nonetheless, these microorganisms consumed nutrients from food for their growth and secrete toxic metabolites (Vijayanandraj et al., 2014). Therefore, this supports the need for eco-friendly plant extracts as biocontrol method. However, the antifungal and detoxification property of Comniphora myrrha and Prunus mahaleb on the antiaflatoxigenic fungi was not tested. This study aiming at investigation of the effects of C. myrrha gum and P. mahaleb seed extract on two antiaflatoxigenic strains namely, A. flavus (SQU21) and A. parasiticus (CBS921.7) [NRRL22999]. The findings will build the knowledge on the bioactivities of these plants and their uses for the advancement in food and feed industries.

2. Materials and Methods

2.1 Aspergillus Flavus and A. Parasiticus Strains

Aspergillus flavus (SQU21) and A. parasiticus (CBS921.7) [NRRL22999] strains from previous study were used (El-Nagerabi et al., 2016) as identified by Raper and Fennell (1965).

2.2 Collection and Characteristics of C. Myrrha Resin and Seeds of P. Mahaleb

The resin granules of C. myrrha and the seeds of P. mahaleb were purchased from the local market of Nizwa, Oman, and were stored at 25-33°C. The resin from the myrrha stem is a yellow fragrant oleo-gum with aromatic
odour (Orwa et al., 2009; Shuaib et al., 2014; Shulan et al., 2011). Ribose and galacturonic acid are the major constituents isolated from C. myrrha oleo-gum-resin (Ammar et al., 2010). The oleo-gum resin contains about 2-8% volatile oil, 23-40% alcohol-soluble resin, 40-60% gum. Chemically it contains series of metabolites such as anti-inflammatory triterpenes (Carvalho et al., 2008; Hanuš et al., 2008; Refat et al., 2011; Shuaib et al., 2014; Shulan et al., 2011). It decreases blood lipids and cholesterol and the guggulsterones act as antagonist ligands (Carvalho et al., 2008). The oil composed of α-pinene, dipentene, limonene, cuminaldehyde, cinnamic aldehyde, eugenol, m-creosol, heerabolene, cadinene, sesquiterpenes, abicyclic sesquiterpenes, formic acid, acetic acid, myrhylic acid, and palmitic acid. The resin composed of acetate, 3-epi-lupenyl acetate, lupeone, 3-epi-α-amirin, α-amirone, acetyl β-eudesmol and a sesquiterpenoid lactone. It is a mixture of furanoeudesma-1,3-dien and linestrene and dihydroxycurzeren of a resinous myrrh odor (Mrongiu et al., 2005). It contains about 15 amino acids and high yields of mixture sugars and acidic oligosaccharides, where in fractions of D-galactose, L-arabinose, and 4-methyl D-glucuronic acid were detected. Two aldobiuronic acids, which present as 6-O-(4-O-methyl-β-D-glucuronosyl)-D-galactose and 4-O-(4-O-methyl-α-D-glucuronsyl)-D-galactose were detected (Hanuš et al., 2008; Soni et al., 2013). Medicinally, it is used for treating various diseases and exhibited interesting biological activities such as anti-inflammatory, antibacterial, antifungal, antimicrobial, antymycobacterial, antioxidant, hepatoprotective, smooth muscle relaxing, antimalarial, anticandidal, antischistosomal, larvicidal, molluscicidal, anticancer, antiulcer and hypolipidemic effects (Ali et al., 2008; Shulan et al., 2011). The dry kernel of mahaleb contains 3.2% crude fat, 2.8% crude protein, 6.3% ash, 5.7% fiber, 82.0% soluble carbohydrates, and trace amounts of fats and protein (Herrera et al., 1981). The seeds have high protein content (31%), cyanogetic glucosides and coumarins including herniarin (7-methoxycoumarin) and coumarin. It was found to contain 31% oil which is abundant in α-oleostearic (38.32%), oleic (31.29%), and linoleic (22.96%) (Sibhi et al., 214). In addition to tannins, traces of hydrocyanic acid, dihydrocoumarin and cyanogenic glucosides of amygdaline (mandelonitrile (Özçelik et al., 2012; Patton et al., 1997; Jerković, 2011). The kernels contain 27-40% fatty oil with unusual composition of conjugated fatty acids including 9, 11, 13-octadecatrienoic acid, conjugated linoleic acid (38.81%), oleic acid (28.45%), linoleic acid (20.67%), palmitic acid (3.74%), stearic acid (2.25%) and arachidic acid (0.3%). Aliphatic hydrocarbons, alcohols, ketones, fatty acids (dodecanec, tetradecanoic, hexadecanoic and linoleic acids), terpenes, C13-norisoprenoids and phenylpropane derivatives (Coumarin 0.3-2.4%) were detected (Jerković, 2011). Terpenes, norisoprenoids and benzene derivatives, minor percentages of aliphatic compounds and furan derivatives were extracted (Oral, 2014).

2.3 Growth of Aspergilli Strains on Media Enriched with Myrrha Resin and Mahaleb Extract

The strains of A. flavus and A. parasiticus were grown on Potato Dextrose Agar (PDA) and incubated for 7 days at ambient temperature (25-32°C). Glass tubes of 5 mm in diameter were sterilized and used to cut several discs from each of the growing fungal colonies. Inoculum from the growing colonies were added to 250 flasks containing 200 ml of yeast malt broth with different concentrations of myrrh resin (0.0%, 1.0%, 1.25%, 2.5% and 3.25% w/v), and mahaleb extract (0.0%, 0.75%, 1.5%, 2.5%, and 3.5% w/v). Three replicates were incubated at 25-32°C for 15 days. Other sets were kept to measure the dry weight of the fungal mycelia using Oven method.

2.4 Effect of the Extracts on Synthetic Aflatoxin B1

Pure aflatoxin B1 of 885 ppb concentration was prepared in 100 ml sterile distilled water. The highest concentrations of resin (3.25%) and mahaleb (3.5%) were separately added to flasks containing pure aflatoxin B1. As a control, flask containing aflatoxin B1 was left without any extract. The flasks were incubated at 25-32°C for 7 days and aflatoxin concentrations were assessed.

2.5 Extraction and Assay of Aflatoxin

Alfa Test-P Affinity method was used for aflatoxin extraction and detection as described by many authors and adopted in our previous study (El-Nagerabi et al., 2012). To the 200 ml fungal culture, 5g of sodium chloride in addition to 100 ml methanol:water (70:30 V/V) as extraction solution were added. To the filterate, 15 ml distilled water were added, mixed, filtered with glass microfilters. Ten ml from the diluted filtrate were passed via Afla-Test-P Affinity Column and the column was cleaned by 10 ml distilled water. The extracted aflatoxin was eluted with one ml methanol (HPLC grade) and one ml of AflaTest developer was added to elute in the cuvette, and vortexed. The aflatoxin concentration was measured by calibrated Vicam fluorometer (Series-4EX) (El-Nagerabi et al., 2016; Elshafie and Al-Shally, 1998).

2.6 Statistical Analysis

One-way ANOVA test (correlation coefficient) under SPSS software (version 11.0) was used to determine the
variation between the effects of different concentrations of *C. myrrha* resin gum and *P. mahaleb* seed extract on aflatoxin inhibition-detoxification and fugal growth.

3. Results and Discussion

3.1 Effect of Myrrh Resin and Mahaleb Extract on Fungal Growth and Aflatoxin Secretion

Worldwide, researchers evaluating the uses of different plant products and microorganisms for biological control of aflatoxinogenic molds (ex: Reddy et al., 2009; Shantha, 1999; Suleiman et al., 2008). Numerous herbs, medicinal and aromatic plants were screened for their antifungal properties (El-Nagerabi et al., 2012, 2013, 2016; Gandomi et al., 2009; Maraga et al., 2007; Montes-Belmont and Carvajal, 1998; Patker et al., 1993; Soher, 1999; Soliman and Badea, 2002). In the present studies, the effect of *C. myrrha* resin, *P. mahaleb* seed extract on the aflatoxicigenic *Aspergillus flavus* and *A. parasiticus* was evaluated. The results showed that the total aflatoxin produced by the two *Aspergillus* strains was significantly (*p*<0.05) inhibited by different concentrations of resin (1, 1.25, 2.5, and 3.25g/100 ml). The total aflatoxin was decreased by 51.9-95.7% (*A. flavus*) and 46.9-92% (*A. parasiticus*) (Fig. 1), and aflatoxin B (*B*1 and *B*2) was inhibited by 51.7-93.5% and 39-89.7%, respectively (Fig. 2). The mycelial dry weights of the two species were significantly (*p*<0.05) decreased with concentrations of resin (Fig. 3). The mycelial dry weight was decreased by 46.1-58.7% (*A. flavus*), and 28.9-51.3% (*A. parasiticus*). On the other hand, the total aflatoxin was significantly (*p*<0.05) inhibited by all tested concentrations of mahaleb seed extracts (0.75, 1.5, 2.5, 3.5g/100 ml) compared to the control. The total aflatoxin inhibition ranged between 53.7-95.6% for *A. flavus*, and 40-94.7% for *A. parasiticus* (Fig. 4), whereas aflatoxin B inhibition was 50-93.6% for *A. flavus* and decreased by 37.9-93% for *A. parasiticus* (Fig. 5). The mycelial dry weight decreased by 45-56.9% for *A. flavus*, and 33.3-55.9% for *A. parasiticus* (Fig. 6).

About 50% of *Aspergillus* are aflatoxin producers including the two strains used in this study (El-Nagerabi et al., 2016). There are some investigations on the uses of myrrh resin for diseases treatment (Abd-Ulgadir et al., 2015; Al Ashry et al., 2013; Ali, 2007; Shuaib et al., 2015), various biological activities such as antibacterial, antifungal (Al-Abdalall, 2013; Al-Daihan et al., 2013; Ali et al., 2008; Dolara et al., 2000; Gadir et al., 2014; Shen et al., 2012; Shulan et al., 2000; Omer et al., 2011; Shuaib et al., 2013). On the other hand, *P. mahaleb* used as spice in home baking (Özcelik and Koca, 2012), folk medicine (Gerardi et al., 2010; Oskoueian et al., 2012; Shams et al., 2007), and against human pathogenic bacteria, fungi, and viruses (Holetz et al., 2002; Perez, 2003; Syeyyednejad, 2008). Extract from different plant parts showed antibacterial and antifungal properties (Özcelik and Koca, 2012), and antibacterial activities against *Proteus mirabilis, Bacillus anthracis, Staphylococcus aureus* (Syeyyednejad et al., 2008). The effect of *C. myrrha* resin and *P. mahaleb* extracts on aflatoxigenic molds was not investigated yet. This encouraged the need for testing their inhibitory nature. The *C. myrrha* resin of between 1-3.25% resulted in 51.9-95.7% inhibition of total aflatoxin production (*A. flavus*) and 46.9-92% (*A. parasiticus*). Aflatoxin B (*B*1 and *B*2) was decreased by 51.7-93.5% for *A. flavus* and 39.5-89.7% for *A. parasiticus* strain. Similarly, *P. mahaleb* seed extracts inhibited the total aflatoxin up to 53.7-95.6% for *A. flavus*, and 40-94.7% for *A. parasiticus*, whereas aflatoxin B inhibition was 50-93.6% and 37-93%, respectively. In similar studies using different plant extracts showed apparent inhibition of the fungal growth and aflatoxin production by aflatoxigenic fungi. *Syzygium aromaticum*, cinnamon, *Curcuma longa, Allium sativum, Ocimum sanctum, Garcinia cowa, A. digitata* (baobab), *Boswellia sacra, Tamarindus indica* and *Hibiscus sabdariffa* effectively inhibit the growth of *A. flavus* and aflatoxin production (Al-Shayeb and Mabrook, 1984; Bullerman et al., 1977; El-Nagerabi et al., 2012, 2013; Joseph et al., 2005; Reddy et al., 2009). The present results showed that the highest inhibition (92-95.7%, 94.7-95.6%) at 3.25% myrrh resin, and 3.5% mahaleb. These findings point the high possibility for the presence of various aflatoxin inhibitors in myrrh resin and mahaleb seed extract which affect the biochemical synthesis of aflatoxin. These chemicals are responsible for the biological properties of these plant extracts (Büchele, et al., 2003; El-Nagerabi et al., 2012, 2013, 2016; Safayhi and Sailer, 1997; Singh et al., 2008.). On the other hand, the addition of different concentrations of *C. myrrha* resin and *P. mahaleb* seed extract to the yeast malt broth inoculated with the two strains, evidently inhibited their growth performance (Fig. 3, 6). Similarly, *C. myrrha* extracts inhibited the growth of both bacterial and fungal standard species (Abd-Ulgadir et al., 2015; Omer, et al., 2011), whereas the oil of *C. myrrha* and *C. molmol* showed antibacterial and antifungal activities and inhibited the growth of *Aspergillus flavus, A. niger* and *Penicillium citrinum* (Al-Abdalall, 2013; Al-Daihan et al., 2013; Ali, 2007; Dolara et al., 2000; Gadir and Ahmed, 2014; Shuaib et al., 2013). Extract from different parts of *P. mahaleb* showed inhibitory effect against gram-positive, gram-negative bacteria and fungal standard strains (Özcelik and Koca, 2012; Syeyyednejad et al., 2008). On the contrary, the fungal growth was enhanced by the high nutritive
extract from fruit of *Balanites aegyptiaca* and *Tamarindus indica* (El-Nagerabi et al., 2013). On the other hand, different concentrations of calyx extract (5-12.5%) from *H. sabdariffa* did not inhibit or enhance the mycelial growth of *Aspergillus* species (El-Nagerabi et al., 2012). Other studies showed different effects on the mold growth and aflatoxin production (Bullerman et al., 1977; Guerin and Reveillere, 1984; Joseph et al., 2005; Reddy et al., 2009). Therefore, it is evident that *C. myrrha* resin and *P. mahaleb* seed extracts contains different chemical inhibitors which affect the biochemical synthesis of aflatoxin as concluded in many studies (Büchele et al., 2003; Da Costa et al., 2010; El-Nagerabi et al., 2012, 2013, 2016; Safayhi and Sailer, 1997; Singh et al., 2008).

### 3.2 Detoxification of Aflatoxin B<sub>1</sub> by Resin of Myrrh and Seed Extract of Mahaleb

The natural plant extracts are biologically safe and ecofriendly for detoxification comparable to the other methods (Alberts et al., 2009; El-Nagerabi et al., 2012, 2013, 2016; Kumar et al. 2009; Oguz, 2011; Prakash et al., 2011). The ability of different herbal, medicinal and aromatic plants as biodegraders to aflatoxin has been reported (Sandosskumar et al., 2007). Root extracts of garlic (*Allium sativum*) and onion (*Allium cepa*) degrade aflatoxin B<sub>1</sub> up to 58.5% (Velazhahan et al., 2010). *Trachyspermum ammi* seed extract degrades 90% of aflatoxin G<sub>1</sub> by modification of lactone ring in the toxin (Velazhahan et al., 2010). Medicinally, *C. myrrha* resin has been used for treatment of various diseases (Al Ashry et al., 2003; Shen and Lou, 2008); rheumatic complaints, tooth decay, gum disease, and helminth infection (Haffor et al., 2010; Abd-Ulgadir et al., 2015), antiseptic, carminative, anti-inflammatory, and tonic in dyspepsia (Omer et al., 2011). It showed many biological activities as antibacterial, antifungal, antimicrobial, antimalarial, anticandidal, antischistosomal, larvicidal, and molluscicidal (Al-Abdalall, 2013; Abd-Ulgadir et al., 2015; Al-Daihan et al., 2013; Ali et al., 2008; Dolara et al., 2000; Gadir et al., 2014; Shen et al., 2012; Shulan et al., 2011). Antimicrobial activity against *Candida albican*, and other microorganisms was reported (Al-Daihan et al., 2013; Dolara et al., 2000; Omer et al., 2011; Shuaib et al., 2013). On the other hand, *P. mahaleb* has been used in many folk medicine and preservation purposes (Gerardi et al., 2010; Oskoueian et al., 2012; Shams et al., 2007). It is used against human pathogenic bacteria, fungi, and viruses (Holetz et al., 2002; Perez, 2003; Syyednejad, 2008). Alcohol extract from different part of the plant showed antibacterial and antifungal activities (Özcelik and Koca, 2012). It showed antibacterial activity against *Proteus mirabilis, Bacillus anthracis, and Staphylococcus aureus* (Syyednejad et al., 2008). In the present investigations, 3.25% (w/v) of *C. myrrha* resin and 3.5% (v/v) of *P. mahaleb* had no significant effect on synthetic aflatoxin, which indicates the lack of detoxification properties compared to their inhibitory effects on aflatoxin production, and fungal growth as concluded by many authors (e.g. Da Costa et al., 2010; El-Nagerabi et al., 2016; Paranagama et al., 2003; Sandosskumar et al. 2007).

![Figure 1. Total aflatoxin production of *A. flavus* strain SQU21 and *A. parasiticus* strain CBS921.7 at different concentrations of *Commiphora myrrha* resin extract (Identical numbers and letters indicate no significant difference, p<0.05)](image_url)

Figure 1. Total aflatoxin production of *A. flavus* strain SQU21 and *A. parasiticus* strain CBS921.7 at different concentrations of *Commiphora myrrha* resin extract (Identical numbers and letters indicate no significant difference, p<0.05)
Figure 2. Aflatoxin B production of *A. flavus* and *A. parasiticus* strains at different concentrations of *C. myrrha* resin extract (Identical numbers and letters indicate no significant difference, *p*<0.05)

Figure 3. Mycelial dry weight of *A. flavus* and *A. parasiticus* strains at different concentrations of *C. myrrha* resin extract (Identical numbers and letters indicate no significant difference, *p*<0.05)

Figure 4. Total aflatoxin secretion by *A. flavus* and *A. parasiticus* strains at different concentrations of *Prunus mahaleb* (Similar numbers and letters indicate showed no significant difference, *p*<0.05)
4. Conclusion

We screened the biological activities of different concentrations of *C. myrrha* resin and *P. mahaleb* seed extract on the growth and aflatoxin production by *A. flavus* (SQU21) and *A. parasiticus* (CBS921.7). These two plant extracts evidently reduce aflatoxin production and the fungal growth which may suggest the inhibitory effect to aflatoxin biochemical synthesis pathway. None of the two extracts detoxify pure aflatoxin B1 as suggested by many researchers (Abulmajeed, 2011; Banno et al., 2006; El-Nagerabi et al., 2012, 2013, 2016; Gupta et al., 2001; Langmead and Rampton 2006; Miller & Morris, 2004; Mothana et al. 2011; Suhail et al. 2011). Therefore, toxicity of biologically active chemical components which reduce aflatoxin production needs more attention. This will build the data on their applications in food preservation industry and pharmaceutical activities.

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