

Full Length Research Paper

# A study of the biological activities of *Avena sativa* extracts

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In Iraq like most third world countries, attempts to extract, identify and study the activity of the active components of plants and use it as drugs. The use of herbal medicine predates the introduction of antibiotics and predates social, economic and religious barriers. The extract of the herb *Avena sativa* L. (Gramineae), from Iraq, was done by using of 70% ethanol as a solvent, the study the antimicrobial activity of the extract (*in vitro*) on gram positive bacteria (*Staphylococcus aureus*), and gram negative bacteria (*E. coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Klebsiella*), *A. niger*, and *Candida*, moreover. The extract showed considerable activity against all bacteria and fungi and it produces significant decrease in blood glucose level, after 1, 2, 4 and 8 h of treatment as compared to untreated diabetic rats.

**Key words:** Antibacterial, arena sativa, extraction, fungal.

## INTRODUCTION

Scientific experiments on the antimicrobial properties of the plants compounds were first documented in the late 19th century (Zaika, 1975). Plants are rich in a wide variety of secondary metabolites such as tannins, terpenoids, alkaloids and flavonoid, which have been found *in vitro* to have antimicrobial properties (Cowan, 1999). Extracts of many plants are now known to exhibit antimicrobial activity. The use of herbal medicine predates the introduction of antibiotics and predates social, economic and religious barriers (Akinoyemi et al., 2000).

Infectious diseases accounts for high proportion of health problems in the developing countries including India. Microorganisms have developed resistance to many antibiotics and as a result, immense clinical problem in the treatment of infectious diseases has been created (Davies, 1994). The resistance of the organisms increased due to indiscriminate use of commercial antimicrobial drugs commonly used for the treatment of infectious disease. This situation forced the researchers to search for new antimicrobial substance from various sources including medicinal plants (Bauer et al., 1996). There are 2600 plant species of which more than 700 are noted for their uses as medicinal herbs (Ali-Shtayeh and

Abu, 1999). In folk medicine, medicinal herbs and plant products were used in treating a wide spectrum of infections and other diseases. A survey of literature reveals that there are many essential oils which possess antifungal activity (Soliman and Badeaa, 2002; Thoppil et al., 2003; Govinden-Soulangue et al., 2004; Romagnoli et al., 2005; Pinto et al., 2006; Tabanca et al., 2007; Tullio et al., 2007; Dutta et al., 2007).

Diabetes is a disease caused by the lack or resistance to the hormone insulin; it is a result from blood sugar level rises as glucose is absorbed into the blood stream the pancreas produce of the insulin to return the blood sugar level to normal (Bothino et al., 1982).

The aim of this work was to study the biological activity of the Iraqi herb *Avena sativa* as antibacterial and antifungal activity.

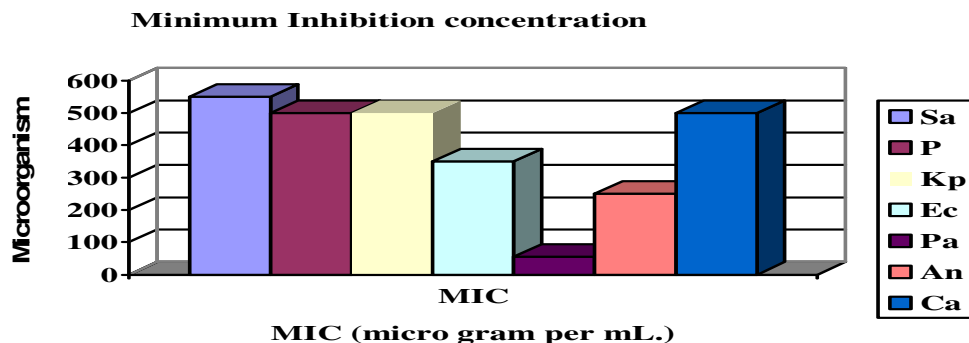
## EXPERIMENTAL

All chemical (except Streptozotocin from Sigma chemicals) used were of reagent grade (supplied by Either Merck or Fluka) and used as supplied.

### Extraction procedure

*Avena sativa* were collected from natural habitats during flowering. Air dried plant sample rinsed with water and dried. After evaporation of the solvent, the residue (250 g) was extracted with 500 ml,

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**Figure 1.** The minimum inhibition concentration [MIC ( $\mu\text{g/ml}$ )] of *avena sativa* extract. Sa = *S. aureus*, P = *P. vulgaris*, K = *K. pneumonia*, Ec = *E. coli*, Pa = *P. aeruginosa*, An = *A. niger*, Ca = *C. albican*.

70% ethanol in a soxhlet apparatus and the extract was evaporated to dryness by a rotary evaporator.

#### Antimicrobial activity assays

Different test microorganisms were used which are: *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella*, *Proteus vulgaris* and *Staphylococcus aureus*, *A. niger*, and *Candida*. All test microorganisms were collected from Biotechnology division, Department of applied science, University of Technology. The identity of all the strains was confirmed. The *Avena sativa* extract was weighed and dissolved in dimethylsulfoxide (DMSO) to prepare extract stock solution of 100 mg/ml.

The antibacterial activity of the *A. sativa* extract was studied against selected types of bacteria, in brain heart broth agar media, which is used DMSO as a solvent and as a control for the disc sensitivity test (Felber and Golay, 2002; Singh et al., 2005; Matencio et al., 2005). This method involves the exposure of the zone of inhibition toward the diffusion of micro-organism on agar plate. The plates were incubated for (24 h), at 37°C. The antimicrobial activity was recorded as any area of microbial growth inhibition that occurred in the diffusion area. The quantitative antibacterial activity assay was performed by the nutrient broth for bacterial.

**Minimum inhibitory concentration (MIC) evaluation:** The MIC was evaluated on plant extract that showed antimicrobial activity. This test was performed at four concentrations of the extract employing the same agar well diffusion method.

**Antifungal assay:** Antifungal activity was tested using the agar dilution method (Collins and Lyne, 1970). Varying concentrations of the extract were prepared and incorporated into potato dextrose agar. The plates were incubated at 25°C for 48 h and inhibition of growth was noted. The minimum inhibitory concentration (MIC) for the extract was recorded after 48 h.

#### Diabetes management

**Animals:** Twenty five male Wistar rats (albino rats) weighing 120 - 160 g aged 3 - 4 months (were obtained from biotechnology division at university of technology) were kept in clean and dry stainless steel cages in the laboratory where the search done under the temperature range (30  $\pm$  5°C), with free access to water and feed.

**Treatment with streptozotocin:** Animals were divided into five groups; each with five rats. The blank group with four groups were rendered diabetic by injecting (using an injection with sterilized filter) streptozotocin solution (50 mg/kg of streptozotocin dissolved in 0.01 M, pH 4.5 acetate buffer) [20] after a base-line blood glucose estimation was done. After 12 days, animals had blood glucose levels of 350 - 400 mg/dl.

**Toxicity test:** The acute toxicity of the ethanolic extract of *avena sativa* was tested on 15 male Wister Albino rats divided into 5 groups of 3 rats each with each group receiving different dose of 50, 100, 150, 250 and 350 mg/kg body weight. The number of deaths in each group was recorded within 48 h. The lethal dosage was estimated.

**Treatment with *A. sativa* extract:** Groups 1 - 4 were given orally, the *A. sativa* extract (suspension in water) at the doses of 25, 75, 125 and 200 mg/kg respectively. Blank group served as control and received equivalent volumes of water.

**Measurement of glucose and insulin in rats' sera:** Normal, diabetic and treated rats were anesthetized with ether. 1 ml of blood was taken from rats in order to measure glucose and insulin (Levi et al., 1977). The samples were collected in sterilized tubes and kept at 4°C. The sera were separated by centrifuging. Blood glucose was measured by the glucose-oxidase method and insulin by radio-immunoassay method (Thulesen et al., 1997).

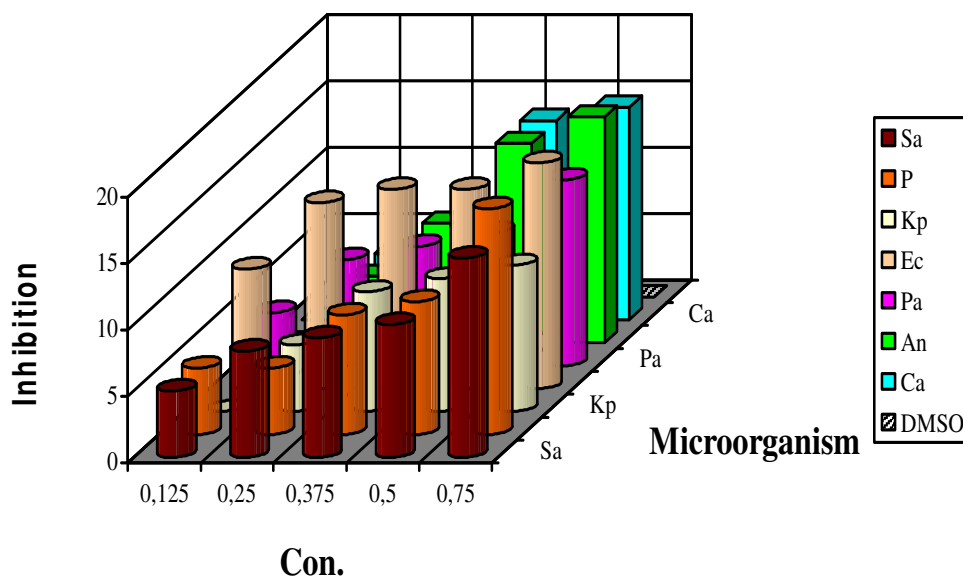
## RESULTS AND DISCUSSION

### Antimicrobial activity of *A. sativa* extract

The determination of the MIC (minimum inhibition concentration) by means of the agar diffusion assay (Figure 1) showed that plant extract tested exhibited an antimicrobial effect against Gram positive bacteria, *S. aureus* and Gram negative, *Klebsiella*, *P. vulgaris*, *Pseudomonas* and *E. coli* in addition of *A. niger*, and *Candida*.

### The antibacterial activity of *A. sativa* extract

The antibacterial activities of the plant extract were



**Figure 2.** The antibacterial and antifungal activity of *avena sativa* extract compared with Ampicillin and fluconazole.

Sa = *S. aureus*, P = *P. vulgaris*, K = *K. pneumonia*, Ec = *E. coli*, Pa = *P. aeruginosa*, An = *A. niger*, Ca = *C. albican*

evaluated by measuring the inhibition zone observed around the tested materials. In agar diffusion assay, the ethanolic extract of the plant showed considerable activity against all tested bacteria (Figure 2).

#### Ethanolic extract of *A. sativa* as diabetes treatments

Diabetes is a pathological condition characterized by the lack of physiological response of peripheral tissue to insulin leading to metabolic and hemodynamic disturbance known as metabolic syndrome (Rother, 2007). Chronic elevation of blood glucose level lead to damage of blood vessel. The risk of diabetes is higher with chronic use of several medications. Diabetes can be treated by increasing physical activity and decrease of carbohydrate that can restore insulin sensitivity (Tuomi et al., 2001). The treatment with *A. sativa* extract might be causes a release of insulin activities to release lipase and improving insulin sensitivity for normalizing blood glucose level and reduce glucose production by the lever, this need may further studies. Normal levels of glucose and insulin in healthy adult rats were measured as  $125 \pm 8$  mg/dl, and  $1.8 \pm 0.3$  mIU/l respectively. Daily urine in healthy adult rats was measured as  $7 \pm 2$  ml 1). But in diabetic rats the levels of glucose, and insulin were measured as  $375 \pm 25$  mg/dl,  $1.6 \pm 0.3$  mIU/l respectively. Daily urine volume in diabetic rats was measured as  $75 \pm 7$  ml. 50 mg/kg body wt. concentration of ethanolic extract of *Avena sativa* produces significant decrease in blood glucose level, after 1, 2, 4 and 8 h of treatment as compared to untreated diabetic rats. After

4 and 8 h of treatment, the percent of reduction in blood glucose level produced by *A. sativa* extract ( $47 \pm 3.2$ ), ( $44 \pm 2.3$ ). After one week of treatment, blood glucose level in diabetic rats treated with *A. sativa* extract decreases (20%) to below normal level. After 2 weeks of treatment, blood glucose level decreases (35%) to below normal level. After three weeks of treatment, blood glucose level decreases (50%) to below normal level. Treatment of diabetic rats by *A. sativa* extract resulted in significant decrease in serum triglycerides TAG, total cholesterol TC and low density lipoprotein cholesterol LDL as compared to untreated diabetic.

#### Conclusion

The ethanolic extract of *Avena sativa* showed good antibacterial activity against gram -positive and -negative bacteria, *A. niger*, and *Candida albican*. Ethanolic extract showed very good activity as decrease in blood glucose level of diabetic rats.

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