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# COMPARATIVE ANTIBIOTIC POTENTIAL OF DIFFERENT VARIETIES OF POTATO TUBERS

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**Keywords:**

*Solanum tuberosum* L., Phytochemical screening, Antimicrobial activity, Agar well diffusion.

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**ABSTRACT: Objective:** Potato (*Solanum tuberosum* L.) is a major world food crop next in production to maize, rice and wheat. Potatoes are a source of dietary energy due to their carbohydrate level and also contain a high value of vitamins. The objective of this study was determine the phytochemical constituents and antimicrobial activities of four common potato varieties developed by CPRI (Central Potato Research Institute, Shimla, India) i.e. Kufri Bahar, Kufri Badshah, Kufri Pukhraj and Kufri Puskar. **Methods:** The antimicrobial activity of selected plant spices against the mentioned microorganisms and their effectiveness were assessed by the presence or absence of inhibition zones and zone diameter by using Agar well diffusion technique and some chemical tests were performed for analysis of phytochemical constituents. **Results:** The antimicrobial activity of all the potato extracts showed the significant inhibitory activity against all the bacteria and fungi strain. **Conclusion:** The demonstration of broad spectrum activity of potato varieties may help to discover new chemical classes of antibiotic substances that could serve as selective agents for infectious disease chemotherapy and control.

**INTRODUCTION:** Potatoes, of any kind, whether they are raw, boiled, peeled, or mashed all have medicinal and healing properties. Even the water that you used to boil them in can be used. A potato's skin is rich in fiber, iron, zinc, potassium, and calcium. It even contains B & C vitamins. Apart from being one of the main and most consumed kinds of food by the world population, the potato has incredible and surprising medicinal values for many people. It contains a small quantity of atropine and like the rest of the members of the Solanaceae family, such as the egg plant and tomatoes; it has an antispasmodic effect that alleviates the intestinal pain and some others ones.

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Potatoes are significant source of natural antioxidants and exhibit antioxidant activity as demonstrated in recent time by many authors [1, 2, 3]. Studies have indicated that these phytochemicals have high free-radical scavenging activity, which helps to reduce the risk of chronic diseases and age-related neuronal degeneration. Potatoes are processed into a variety of products such as mashed potatoes, chips, fries, deep frozen and dehydrated products like granules and flakes. Furthermore starch is an economically important product obtained in large quantities from the tubers[4, 5].

Generally, the skins and/or fleshes of the stem tubers of the ordinarily cultivated varieties of potato (*Solanum tuberosum* L.) are white, yellow, lemon yellow or saffron yellow [6, 7]. Worldwide, the potato cultivars in which the skins and/or fleshes of the stem tubers are red, purple, blue or orange are intuitively denominated colored potatoes, colorful potatoes or pigmented potatoes[8, 9,10,11]. The aim of this study was to determine unrevealed properties

of potato, using the set of potatoes, varieties developed by CPRI (Central Potato Research Institute, Shimla, India) i.e Kufri Bahar, Kufri Badshah, Kufri Pukhraj and Kufri Puskar [12, 13, 14], how the antimicrobial activity depend on their morphological differences, and if there are some differences among antimicrobial activities then what about the preliminary phytochemical screening to identify the chemical constituents.

**Kufri Pukhraj** is high yielding potato varieties. The plant is tall, semi erect, medium compact, with few green and moderately developed straight stems. Tubers are white in color, large, oval with smooth skin and yellow flesh. It produces blue-purple sprouting.

**Kufri Bahar** is grown in parts of Haryana, Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh. Plant is tall, erect, medium compact and vigorous. Stems are few, thick, colored at base with moderately developed straight wings. It sprouts green or red.

**Kufri Badshah** tubers are white, large, and oval with smooth skin, fleet eyes and dull white flesh. It produces light red sprouting. K.Badshah is adaptable for, parts of Gujarat, Haryana, Jammu and Kashmir, Madhya Pradesh, Punjab and Uttar Pradesh.

**Kufri Puskar** is a high yielding medium maturing white tuber variety having field resistance to late blight and excellent keeping quality under ambient storage conditions. It is suitable for cultivation in plains and plateau regions of the country. Specific areas for its adaptation are Haryana, Punjab, Rajasthan, Uttar Pradesh, Bihar, Maharashtra and Karnataka. Most striking feature of this variety is its good keeping quality which can be very helpful in its wider acceptability and greater utilization. Other important features of Kufri Pushkar include uniformity in tuber size and suitability for early (September) planting heat stress conditions [15, 16].

## MATERIALS AND METHODS:

### Collection of plant materials

The different varieties of potatoes were procured from Department of Vegetable Crops, Haryana Agriculture University (HAU), Hisar (Haryana, India).

### Extract Preparation

The tubers of all four potato varieties were washed and crushed with the help of motor and pestle. The filtrate was prepared and used as the crude extract.

### Procuring of bacterial strain

Pure cultures of test organisms were procured from IMTECH (*Microbial Type Culture Collection)*, Chandigarh, India **(Table1)**.

**TABLE 1: LIST OF MICROORGANISMS USED IN THE STUDY**

| Name of Bacterial Strain | MTCC NO. | Name of Fungal Strain | MTCC NO. |
|---|---|---|---|
| *Bacillus subtilis* | 121 | *Aspergillus fumigatus* | 4163 |
| *E.coli* | 483 | *Aspergillus niger* | 1344 |
| *Bacillus amyloliquefaciens* | 1488 | | |
| *Staphylococcus aureus* | 96 | | |
| *Staphylococcus epidermidis* | 435 | | |
| *Streptococcus mutans* | 890 | | |

### Preparation of Standard Culture inoculums

A loop full of the different strains were inoculated in 25 ml nutrient broth in a conical flask and incubated at room temperature on a rotary shaker for 24 hr. The optical density was measured at 625 nm after 24 hrs using a spectrophotometer. The prepared culture was appropriately diluted with nutrient broth to achieve sufficient inoculums. The bacterial strains were maintained on nutrient agar at $4^0$C and sub cultured every month. The fungal strains were separately inoculated on to Czapek yeast agar for 3-4 days before being used for antifungal assay.

### Determination of antimicrobial activity by agar well diffusion method[14, 18]

Petri plates containing 20 ml of Nutrient agar (for bacterial culture) and Czapek yeast agar medium (for fungal suspension culture) were inoculated with 100µl of diluted bacterial culture by the spread plate technique and were allowed to dry in a sterile chamber. A well of about 7.0 mm was aseptically punctured with sterile cock borer. 150µl of the extracts (200mg/ml) were loaded into the wells and were allowed to dry completely. The tests were carried out in Triplicates. Plates were incubated at 37ºc for 24 hrs. The antimicrobial

activity was assessed by measuring the zone of inhibition.

**Phytochemical Analysis of Extract**

The different potato extracts were subjected to preliminary phytochemical screening to identify the chemical constituents [4, 18].

**RESULTS AND DISCUSSION:**

The agar well diffusion method results showed that extracts from K. Badshah, K. Bahar, K. Pukhraj and K. Puskar were effective against bacterial strains with zone of inhibition in the range 7 mm to 27 mm and 15mm to 33.5mm against fungal strains **(Table 2 and 3)**. K. Puskar showed maximum antibacterial activity against *B. subtilis and B. amyloliquefaciens* with 27 mm and 26 mm zone of inhibition respectively. *B. subtilis* was also found to highly sensitive against Kufri Badshah with 25.5 mm zone of inhibition. *B. amyloliquefaciens and S. mutans* were found to be less effective against K. Bahar with 7 mm zone of inhibition. The results from **Table 3** showed that the potato extracts had significant antifungal activity against *Aspergillus fumigatus* and *Aspergillus niger*. *Aspergillus fumigatus* was found to be most sensitive against K. Pukhraj with 33.5 mm zone of inhibition while *Aspergillus niger* showed maximum sensitivity against K. Bahar extract with 30.5 zone of inhibition. *Aspergillus niger* showed minimum sensitivity against K. Pukhraj with 15 mm zone of inhibition.

**TABLE 2. ANTIBACTERIAL ACTIVITY OF EXTRACTS OF POTATO TUBER/FLESH AGAINST BACTERIAL STRAINS (CONCENTRATION OF EACH EXTRACTS 150 µl)**

| Potato Varieties | *B. amyloliquefaciens* | *B. subtilis* | *E. coli* | *S. aureus* | *S. epidermidis* | *S. mutans* |
|---|---|---|---|---|---|---|
| | Diameter of zone of inhibition in millimeters | | | | | |
| K.Badshah | 14 | 25.5 | 25 | 22 | 15 | 7 |
| K.Bahar | 7 | 24.5 | 23 | 23 | 15 | 8 |
| K.Pukhraj | 15 | 22 | 22.5 | 14.5 | 17 | 22 |
| K.Puskar | 26 | 27 | 16 | 15 | 18 | 21 |

**TABLE 3. ANTIFUNGAL ACTIVITY OF EXTRACTS OF POTATO TUBER/FLESH AGAINST FUNGAL STRAINS (CONCENTRATION OF EACH EXTRACTS 150 µl)**

| Potato Varieties | *Aspergillus fumigatus* | *Aspergillus niger* |
|---|---|---|
| K.Badshah | 22 | 29.5 |
| K.Bahar | 25 | 30.5 |
| K.Pukhraj | 33.5 | 15 |
| K.Puskar | 20.5 | 30 |

Many of phytochemical substances serve as plant defense mechanism against invasion by micro-organisms, insects and herbivores and some of them are also responsible for odor (quinines and tannins) plus pigment of the plant[5].

**Table 4** showed that extracts from K. Bahar, K. Badshah, K. Pukhraj and K. Puskar were found positive for the presence of aldehydes and flavanoids. Results for all potato extracts were found positive for the presence of carbohydrates through both the tests (Molisch and Fehling tests). The results from tests conducted for presence of tannins, saponins, glycosides and steroids were recorded as negative for all the four extracts. As these compounds have significant application against human pathogens, including those that cause enteric infections and are reported to have curative properties against several pathogens and therefore could suggest their use in the treatment of various diseases[19,20].

It is not surprising that there were differences in the antimicrobial effects of plant species, due to the phytochemical properties and differences among species. It is quite possible that some of the plants that were ineffective in this study do not possess antibiotic properties, or the plant extracts may have contained antibacterial constituents, just not in sufficient concentrations so as to be effective. It is also possible that the active chemical constituents were not soluble in used solvents.

**TABLE 4. PHYTOCHEMICAL ANALYSIS OF POTATO VARIETIES**.

| Phytochemical | Constituents | K.Badshah | K.Bahar | K.Pukhraj | K.Puskar |
|---|---|---|---|---|---|
| Aldehyde | Tollen's test | + | + | + | + |
| Alkaloids | Mayer's test | – | – | – | – |
| | Hager's test | – | – | – | – |
| Carbohydrates | Molisch's test | + | + | + | + |
| | Fehling's test | + | + | + | + |
| Flavanoids | With NaOH | + | + | + | + |
| | With $H_2SO_4$ | + | + | + | + |
| Glycosides | Keller Test | – | – | – | – |
| Phenols | $FeCl_3$ Test | + | + | + | + |
| Steroids | | – | – | + | + |
| Saponins | Foam Test | – | – | – | – |
| Terpenoids | | – | – | – | + |
| Tannins | $FeCl_3$ | – | – | – | – |
| | Lead Acetate | – | – | – | – |

**CONCLUSIONS:** Antibiotics resistance is increasing day by day among micro-organisms due to the spread of resistant genes via plasmid throughout other species, eventually limiting the efficacy of various drugs. The priority for the next generation or decades must be focused in the development of alternative drugs and/ the recovery of molecules that would allow the consistent and proper control of microorganisms which cause diseases. Ideally, these molecule should be as natural as possible with a wide range of activity over several harmful bacteria and fungal strains, easy to produce and not prone to induce resistance, with minimal residual effect.

The present study reveals the scientific validation of potato tubers for the use as antimicrobial agents. The presence of wide range of Phytochemical present in the plants may be a reason for the antimicrobial activity possessed by the plants. The authentication present study may help to discover new chemical classes of antibiotic substances that could serve as potential agents for new antimicrobial drugs. The effect of these plants on more pathogenic organisms, and toxicological investigations and further purification, however, need to be carried out.

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**REFERENCES:**

1. Hamouz K, Lachman J, Pazderů K, Tomasek J, Hejtmánková K, Pivec V. Differences in anthocyanin content and antioxidant activity of potato tubers with different flesh colour. Plant Soil Environ 2011; 10: 478–485.
2. Nara K, Miyoshi T, Honma T, Koga H. 2006. Antioxidative activity of bound-form phenolics in potato peel. Bios, Biotech, Biochem 2006; 70: 1489-1491.
3. Faride H, Gholam RB, Reza T T. Evaluation of antioxidant activity of three common potato (*Solanumtuberosum*) cultivars in Iran. Avicenna Journal of Phytomedicine 2012: 79-85.
4. Lachman J, Hamouz K, Orsák M, Pivec V. Potato tubers as a significant source of antioxidants in human nutrition. Rostlinná Výroba 2000; 46: 231–236.
5. Schieber A, Marleny D, Saldana A. Potato peels: A source of nutritionally and pharmacologically interesting compounds. A review-Global Science Book 2009.
6. Bergthaller W, Witt W, Goldau H-P. Potato starch technology.Starch/starke 1999; 51: 235-242.
7. Hayashi K, Suzuki A, Tsukui A, Takamatsu N, Naito K, Okada T, Mori M, Umemura Y. Characteristic anthocyanin, vitamin C, dietary fiber and sucrose contents of new types of colored potatoes. Nihon Kasei Gakkaishi 1997; 48: 589-596.
8. Brown CR, Wrolstad R, Durst R, Yang CP, Clevidence B. Breeding studies in potatoes containing high concentrations of anthocyanins. American J. Potato Res 2003a; 80: 241-249.
9. Lachman J, Hamouz K. Red and purple coloured potatoes as a significant antioxidant source in human nutrition -a review. Plant Soil Environ 2005; 51: 477-482.
10. Reyes LF. Antioxidant capacity, anthocyanins and total phenolics in purpleand red-fleshed potato (*Solanum tuberosum* L.) genotypes. Ame J Potato Res 2005; 82: 271-277.
11. Liu YW, Han CH, Lee MH, Hsu FL, Hou WC. Patatin, the tuber storage protein of potato (*Solanum tuberosum* L.) exhibits antioxidant activity *in vitro*. J Agri Food Chem. 2003; 51: 4389-4393.
12. D. Rodriguez DS, Hadley M, Wolf-HallC. Potato peel Extract a Nonmutagenic Antioxidant with Potential Antimicrobial Activity. Journal of Food Science 1998; 63:5: 907–910

13. Central Potato Research Institute, Shimla, India. http://cpri.ernet.in/?q=node/91
14. Singh G, Sharma M, Kumar A, Verma S, Goel D. Preliminary Phytochemical analysis and Screening of potential antibacterial activity of Plant Extracts Against Pathogenic Strains of *Nocardia Asteroids* And *Streptococcus Pyogenes*. International Journal Of Pharmaceutical Research And Bio-Science 2013; 2(5):100-107
15. Pandey SK, Singh JP and Gopal J. Potato varieties and cropping systems In India. Potato J.2008; 35: 103-110.
16. Jatav MK, Kumar M, Trehan SP, Dua VK and Kumar S. Effect of Nitrogen and varieties of potato on yield and agronomic N use efficiency in North-Western plains of India. Potato J; 2013; 40 (1)
17. Dua VK, Singh BP, Govindakrishnan PM, Kumar S, Lal SS. Impact of climate change on potato productivity in Punjab – a simulation study. Current science; 2013 105: 6-25.
18. Pannu J, Thalwal S, Gupta A. Comparison of antimicrobial activity and Phytochemical Constituents of *in vivo* and *in vitro* Grown *Amaranthus Spinosus* Plants. Int J Pharm Pharm Sci, 2013; 5:703-707.
19. Shihabudeen MS, Priscilla HD,Kavitha T. Antimicrobial activity and phytochemical analysis of selected Indian folk medicinal plants. International Journal of PharmaSciences and Research 2010; 1: 430- 434.
20. Hassan MM, Oyenwale AO, Abduallahi MS, Okonkwo EM. Preliminary phytochemical and antibacterial investigation of crude extract of the root bark of *Datarium microcarpum*. J ChemSoc Nigeria 2004; 29: 26-29

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