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Research Article

EFFECT OF POTASSIUM SORBATE ON THE INHIBITION OF GROWTH OF FUNGI ISOLATED FROM SPOILED BAKERY PRODUCTS

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Abstract

Bakery products are an important part of food expenditure. Bakery products, like all processed food products are subjected to spoilage *viz.*, physical spoilage, chemical spoilage and microbial spoilage. Microbiological spoilage is often the major factors limiting the shelf life of bakery products. Mould spoilage is a serious and costly problem for bakeries. Sorbic acid is effective against bacteria, and especially molds and yeasts. In the present study, the effect of chemical preservative sorbates against the bakery food spoilage fungi was tested in different concentrations, pH and temperature respectively. Among the various concentrations, 0.25 %, pH 7.5 and 20 °C was highly effective in the control of *Rhizopus stolonifer*, *Aspergillus niger*, *Penicillium chrysogenum* and *Mucor* sp.

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1. Introduction

Bakery products and cereals are a valuable source of nutrients in our diet providing us with most of our food calories and approximately half of our protein requirements. Importance of bakery products has expanded especially the use of whole and natural grains and other natural ingredients. Furthermore, bakery products are considered as a source of carbohydrates because starch is the main chemical constituent (Jageethadevi *et al.*, 2012). Bakery products are subjected to spoilage problems. These include physical, chemical and microbial spoilage. Since, the most common factor of bakery products is water activity, microbiological spoilage, in particular mould growth is the major economical importance of bakery products. Mould spoilage is a serious and costly problem for bakeries (Saranraj and Geetha, 2012).

The stability of bakery products against the attack by fungi is mainly due to preservatives. Preservatives help to reduce or prevent wastage of food through spoilage caused by microorganisms. Longer shelf life enables a greater variety of products to be kept in store and in the home. Sofos and Busta (1991) reported that the chemical preservatives can control the growth of molds by preventing the metabolism, by denaturing the protein of the cell, or by causing physical damage to the cell membrane. Among these preservatives are propionic and sorbic acid or their salts which have been show to increase the shelf life of bakery products. Propionic acid and calcium propionate are usually employed at concentrations of 0.1 and 0.2 per cent respectively. At these levels, moulds

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can be inhibited for 2 days or more and the formation of rope can be prevented (Seiler, 1994).

2. Materials and Methods

Collection of bakery foods

Five different spoiled bakery foods were collected from the Bakery in Chidambaram town, Tamil Nadu, India. The collected spoiled bakery foods were;

a) Wheat bread.
b) Sponge cake.
c) Plum cake.
d) Chocolate cake.
e) Putting cake.

Isolation and identification of fungi from bakery foods

The samples were processed for the estimation of fungal population by dilution plating method by suspending 1g of each sample in 100 ml sterile water in conical flask. The flask was kept in mechanical shaker for 5 minutes to prepare the suspension. 1 ml of aliquots was pipetted out to 10 ml sterile water and dispersed uniformly by shaking. Transferred 1 ml repeated till a dilution of 10^{-4} or 1/10,000 was obtained. Aliquots of 1 ml of the serial dilution 10^{-3} and 10^{-4} were pipetted out to sterile petridishes and the plates were poured with SDA medium. The medium was allowed to set and incubated in inverted position. All plates were incubated at room temperature for 3 days. The colonies were counted and expressed per gram of bakery products.

The Lactophenol cotton blue (LPCB) mount was especially used to identify the fungus. In this a drop of LPCB was placed on a clean slide. With the help of the teasing needle small portion of the colony was picked and it was spread on LPCB by using another teasing needle. Then, the cover slip was placed over that without any air bubbles. Then, the slide was examined under 45x objective lens in microscope.

Effect of potassium sorbate on the inhibition of fungal growth

The inhibitory effects of different concentrations of the chemical preservative Potassium sorbate on the fungal growths were studied by following the method of Grundy (1996).

Sabouraud's dextrose broth was prepared and distributed at 50 ml quantities in 100 ml Erlenmeyer flasks in different concentration. The preservatives (0.0%, 0.5%, 0.10%, 0.15%, 0.20%, and 0.25%) were prepared and added to the broth and inoculated with 1 ml of fungal inoculums separately and incubated at room temperature for 3 days. After the incubation period, the growth were measured at 420 nm using Spectrophotometer.

Effect of potassium sorbate at different pH on the inhibition of fungal growth.

Sabouraud's dextrose broth was prepared and distributed at 50 ml quantities in 100 ml Erlenmeyer flasks in different concentration. The preservative (0.0%, 0.5%, 0.10%, 0.15%, 0.20%, and 0.25%) were added to the broth and the pH was adjusted to various level from 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5 and 8.0 in each flask by adding 0.1 N NaOH or 0.1N HCl or and pH in each broth was tested with the help of glass electrode pH meter. The flasks were inoculated with 1 ml of fungal inoculums separately and incubated at room temperature for 3 days. After the incubation period the growths were measured at 420 nm using Spectrophotometer.

Effect of potassium sorbate at different temperature on the inhibition of fungal growth.

Sabouraud's dextrose broth was prepared and distributed at 50 ml quantities in 100 ml Erlenmeyer flasks in different concentration. The preservative (0.0%, 0.5%, 0.10%, 0.15%, 0.20%, and 0.25%) were prepared and added to the broth and inoculated with 1 ml of fungal inoculums separately and incubated for 3 days at different temperature *viz*., 10 °C, 15°C, 20 °C, 30 °C, 35 °C, 40 °C, and 45 °C in an incubator. After the incubation period the growths were measured at 420 nm using Spectrophotometer.

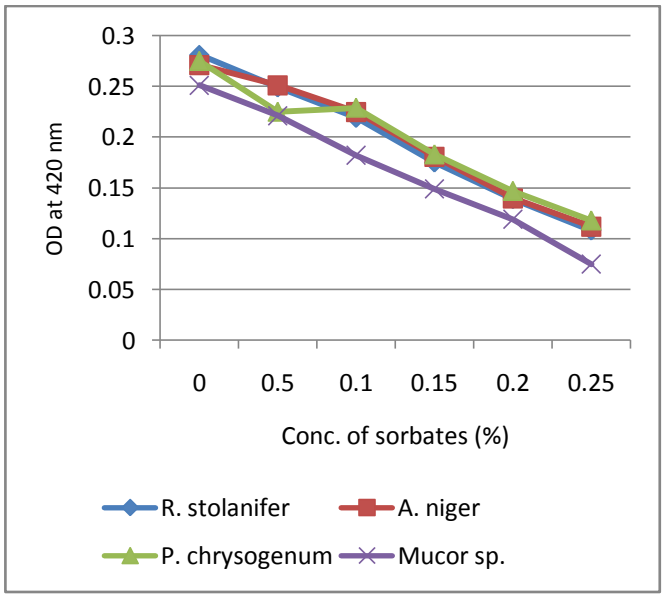
3. Results and Discussion

Spoilage by mold is one of the major problems in bakery food and these results will cause more economic losses. In this present study,

five different bakery products *viz.*, wheat bread, sponge cake, plum cake, chocolate cake and putting cake were collected from the bakery in Chidambaram. The isolated cultures were identified as *Rhizopus stolonifer*, *Aspergillus niger*, *Penicillium chrysogenum* and *Mucor* sp.

In this study, the effect of Potassium sorbates against the bakery food spoilage fungi isolated from the spoiled products was tested and the results were showed in Fig - 1. The preservative were used in different concentrations *viz.*, 0.0%, 0.5%, 0.10%, 0.15%, 0.20%, and 0.25%. Among the various concentrations of Potassium sorbates used, 0.25% was highly effective in the control of *Rhizopus stolonifer* (0.108 at 420 nm), *Aspergillus niger* (0.112 at 420 nm), *Penicillium chrysogenum* (0.118 and *Mucor* sp. (0.075 at 420 nm).

Fig-1. Effect of Potassium sorbates on the inhibition of fungal growth



In the present study, the effect of the Potassium sorbates against bakery food spoilage causing fungi was tested under different pH (4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, and 8.0) and the results were showed in Fig - 2, Fig - 3, Fig - 4 and Fig - 5. The preservative were used in different concentrations *viz.*, 0.0%, 0.5%, 0.10%, 0.15%, 0.20% and 0.25%. The growth of the fungi *Rhizopus stolonifer* (0.045 at 420 nm) was highly inhibited at pH 7.0, *Aspergillus niger* (0.042 at 420 nm) and *Penicillium chrysogenum* (0.051 at 420 nm) was highly inhibited at pH 7.5. The growth of the fungi *Mucor* sp. (0.049 at 420 nm) was inhibited at pH 6.5. For all the fungal isolates, the growth was completely arrested at pH 4.0 and 8.0 (Sofas and Busta, 1991; Darwina *et al*., 2012).

Fig – 2:Effect of Potassium sorbates at different pH on the inhibition of *Rhizopus stolonifer* growth

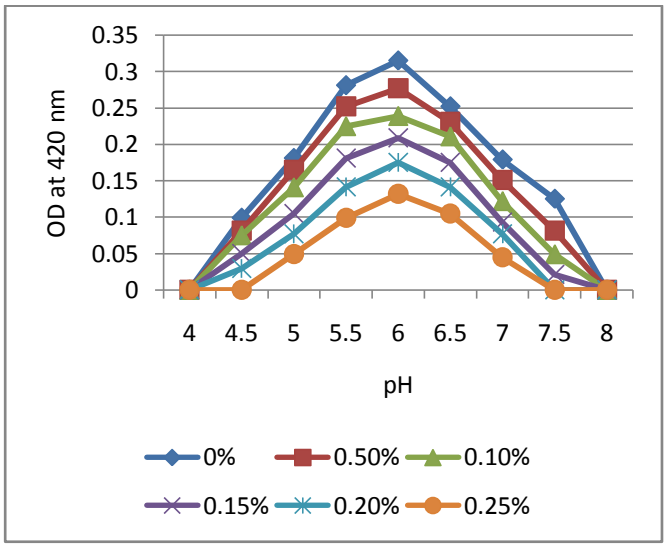


Fig – 3: Effect of Potassium sorbates at different pH on the inhibition of *Aspergillus niger* growth

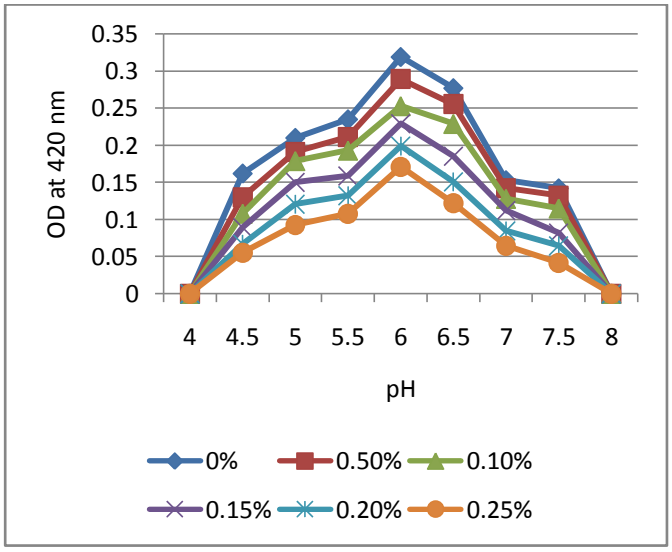


Fig – 4: Effect of Potassium sorbates at different pH on the inhibition of *Penicillium chrysogenum* growth

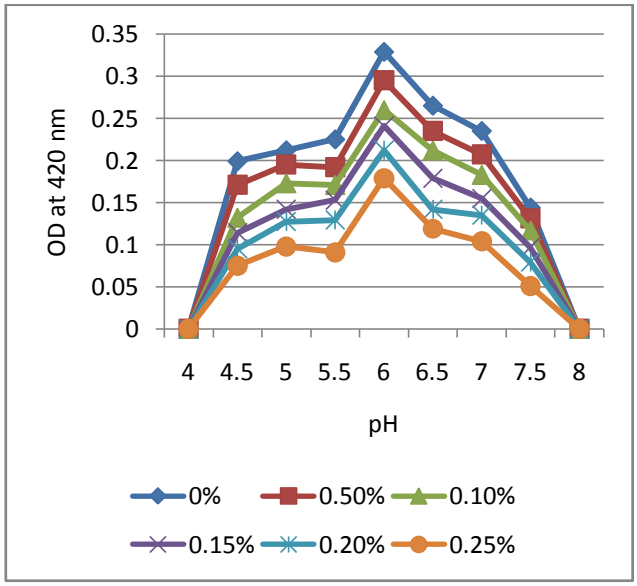
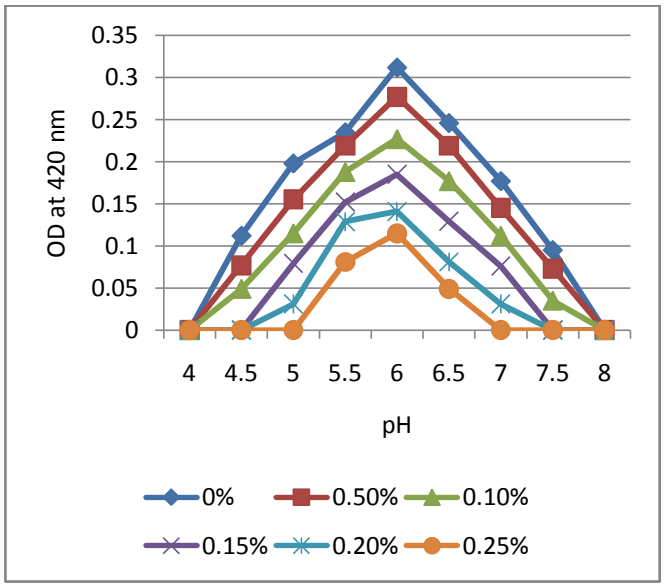


Fig-5: Effect of Potassium sorbates at different pH on the inhibition of *Mucor* sp. growth



In this research, the effect of chemical preservative Potassium sorbate against bakery food spoilage fungi was tested under different temperature (10 °C, 15 °C, 20 °C, 30 °C, 35 °C, 40 °C and 45 °C) and the results were showed in Fig - 6, Fig - 7, Fig - 8 and Fig - 9. The preservative were used in different concentrations *viz.*, 0.0 %, 0.5 %, 0.10 %, 0.15 %, 0.20 % and 0.25 %. The growth of the fungi *Rhizopus stolonifer* (0.144 at 420nm) and *Aspergillus niger* (0.143 at 420 nm) and *Mucor* sp. (0.079 at 420 nm) was highly inhibited at 20 °C. Whereas, the growth of the fungi *Penicillium chrysogenum* (0.095 at 420 nm), was inhibited at 15°C. For all the fungal isolates, the growth was completely inhibited at 10 °C, 40 °C and 45 °C.

Fig – 6: Effect of Potassium sorbate at different temperature on the inhibition of *Rhizopus stolonifer* growth

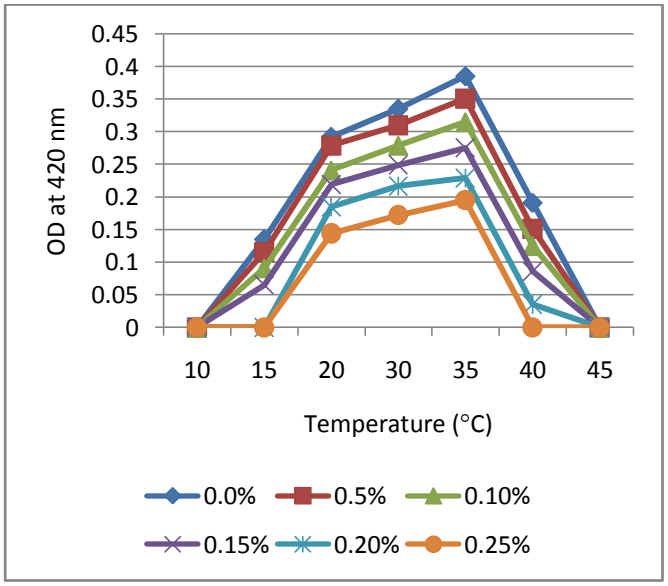
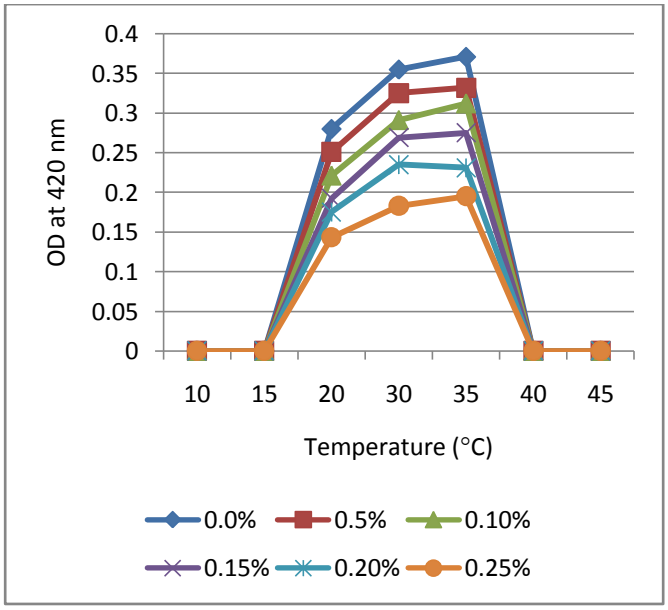


Fig – 7: Effect of Potassium sorbates at different temperature on the inhibition of *Aspergillus niger* growth



In general, Potassium sorbic acid is effective against bacteria, and especially molds and yeasts.

The major commercial use of sorbate is as a fungistatic (Liewen and Marth, 1995). Several studies have demonstrated the inhibitory effect of potassium sorbate on mold growth in food products. Ray and Bullerman (2001) reported that potassium sorbate exhibited a great effect on the growth of *Aspergillus niger* and *Penicillium* species. Sauer and Burroughs (1993) observed that mold was inhibited for 2 weeks by using 0.5 per cent potassium sorbate.

Fig – 8: Effect of Potassium sorbates at different temperature on the inhibition of *Penicillium chrysogenum* growth

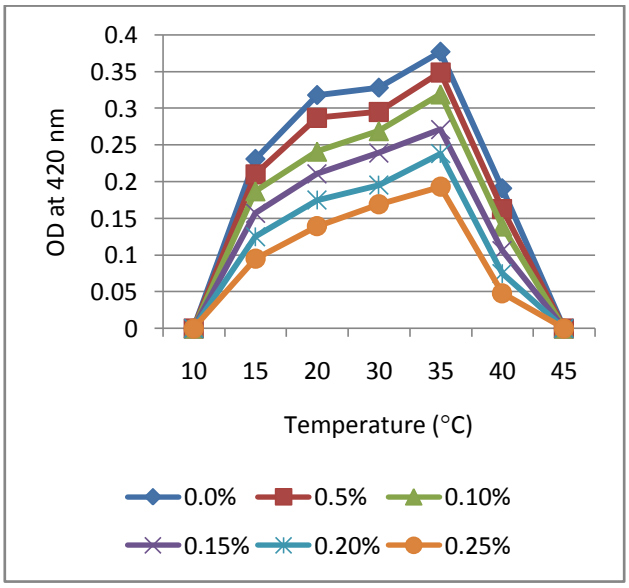
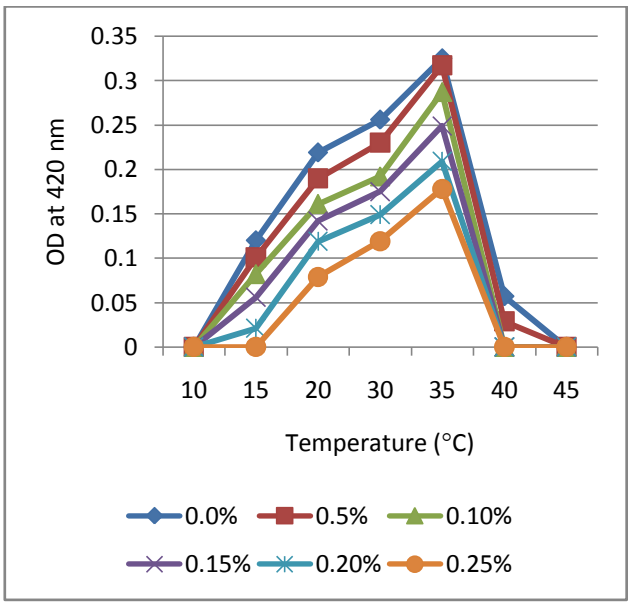


Fig – 9: Effect of Potassium sorbates at different temperature on the inhibition of *Mucor* sp. growth.



The levels of Potassium sorbate used in bakery products ranges from 0.001 - 0.3 per cent (Sofos, 1991). These concentrations have no major impact on food quality, but higher levels may cause undesirable changes in taste and flavor. Sorbates are more than twice as effective than propionates in inhibiting mold growth in bakery products, but have an adverse effect on yeast, reducing loaf volume and making dough sticky and difficult to process (Legan, 1993). This problem can be overcome by either spraying sorbate onto the product's surface after baking or mixing anhydrates of sorbic acid with fatty acids, such as palmitic. In addition, sorboyl palmitate has also been successful in controlling mold growth without interfering in the fermentation process. The heat of the baking process hydrolyses sorboyl palmitate and releases sorbic acid which inhibits molds during storage (Geetha *et al*., 2012). Sorbate acts synergistically with sodium chloride, calcium propionate, sodium propionate, citric acid and sucrose achieving a longer shelf life (Saranraj and Naidu, 2014).

4. References

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