**Natural preservatives in poultry meat products**

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**Abstract**

In view of certain disadvantages associated with the use of chemical preservatives, emphasis is being given on the use of natural preservatives for meat products. In present paper utilization of extracts of commonly used spices, desirable microbes and or their metabolites and certain antimicrobial constituents of other foods has been discussed.

**Key words:** Poultry meat, natural preservatives, microbes’ metabolites, antimicrobial constituents, spices, garlic, cinnamon, clove.

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**Introduction**

There is growing consciousness among consumers for foods with high nutritional value, free from chemical preservatives and microbiological safety. Meat is an ideal medium for bacteria because of high moisture content, richness in nitrogenous compounds (essential amino acids, proteins), good source of minerals, vitamins and other growth factors. Furthermore, its pH is favourable for the growth of microorganisms.

The meat preservatives restrict microbial activity, enzymatic, chemical and physical reactions that cause deterioration and spoilage of meat and meat products. Meat preservation works by lowering the amount of substances in meat that pathogen/microbes prefer to grow on. The best way to preserve meat is to either lower the water content by thermal treatment or lower the pH of the meat or both. In addition, other methods of meat preservation include storage of meat at lower (refrigeration or freezing) temperature, irradiation or use of chemical preservatives including organic acids and humectants to lower a_w. Chemical preservatives, however, are not preferred now-a-days due to their residual effect and declining consumer preference. Therefore, emphasis is on the use of natural preservatives. The natural preservatives discussed here have been categorized into plant-derived products (herbs and spices), desirable microbes and/or their metabolites (bacteriocins) and certain antimicrobial constituents of other foods (lysozyme, conalbumen, avidin, etc.).

**Plant based preservatives**

Plants contain some aromatic chemicals for their protection and perpetuation of their species. The aroma in plants exists in the form of a precursor, which gets decomposed by enzymes when plant tissue is damaged instantly, creating an anti-bacterial aroma. The use of spices and herbs as flavouring agents in foods is being practiced for centuries but it is only in recent years that modern science has started paying much attention to the exploitation of desirable properties of spices. The aroma and anti-microbial properties of spices and herbs are related to their essential oil contents, which are volatile oils, obtained by distillation and enzymatic action. Utilization of spices in
the form of powder, extracts or essential oils to check growth of many spoilage bacteria and fungi in foods have been well documented (Meena and Sethi, 1997; Subbulakshmi and Naik, 2002; Rajkumar and Berwal, 2003). Though the antimicrobial activity of spices depends on type of test organism, nature and concentration of spice/herb, test medium and other factors also taken into consideration for testing the activity. Most of the work on spices is going on to isolate their active principle in pure form and to use them for commercial use. Many companies are interested to investigate the beneficial properties of these spices especially in the marketable form just like vitamin supplements. For this, they need to know exactly what is the active ingredient present in a particular spice and how much of it is required for preservation of meat or other food products. Antimicrobial effects of spices such as garlic, cinnamon and clove against many bacteria such as *Salmonella typhimurium*, *Escherichia coli*, *Staphylococcus aureus* Rosenb., *Bacillus cereus* Frankl & Frankl, *Aspergillus* sp. and *Candida albicans* (Robins.) Berk. have been reported (Shelef, 1983).

**Garlic, Allium sativum Linn.**

Garlic or *Lahsun* is known for the medicinal value of its essential oil (0.3-0.5%). There is some evidence that faecal bacteria generate superoxide free radicals, which inhibit the growth of high superoxide generating bacteria. Potentiality of using garlic as poultry meat preservatives has been evaluated in culture media as it inhibited bacterial pathogens such as *Staphylococcus aureus*, *Salmonella typhi*, *E. coli* and *Listeria monocytogenes* in culture broth, however, *E. coli* was found to be most sensitive and *Listeria* as most resistant (Kumar and Berwal, 1998). Aqueous garlic extract (AGE) has been recently evaluated for its effectiveness in preservation of poultry meat and in one study conducted on minced chicken meat it was found that incorporation of AGE at 4.0% (v/w) level in minced chicken meat (MCM) extended shelf life of MCM to one more day as compared to control (untreated) group during refrigerated (4 ±1°C) storage (Yadav et al., 2002) in the author's laboratory. In another study AGE at 4.0% (v/w) level in combination with *Lactobacillus acidophilus* (LA bacteria) inhibited mesophilic and psychrophilic bacteria and both these in combination exerted synergistic effect and extended the shelf-life of minced chicken meat to 6 days as compared to 4 days shelf-life of control (untreated) group. The combination of AGE and LA culture was also found effective in checking the growth of spoilage and pathogenic bacteria such as *Aeromonas hydrophila* in refrigerated storage of minced chicken meat. The combination of AGE and lactic acid at 0.08 % (v/w) level in model chicken meat system delayed the toxin production by *E. coli* during refrigerated storage.

Incorporation of different levels (1, 2 and 3 %, v/w) of ethyl alcoholic garlic extract in processed chicken meat products exhibited potent antimicrobial effect with 2.0% level rendering microbiologically safe chicken till 14 days of refrigerated storage. In chicken gizzard snacks, it was found that both vinegar-based garlic extract and water-based garlic extract were found effective in checking the microbial growth, however, the former extract was more effective in controlling microbial growth than the latter extract. Garlic extract (8.0% v/w) treated chicken gizzard snacks remained microbiologically safe and organoleptically acceptable upto 14 of refrigeration (4 ±1°C) storage.

**Cinnamon, Cinnamomum zeylanicum Breyn.**

Cinnamon or *Dalchini* is amongst the spices that have been known to preserve foods. Bark acts as an antimicrobial component of cinnamon. It contains 0.5 to 2.0 % volatile oils of which cinnamic aldehyde and eugenol are main active principles. Cinnamon was found to be antimicrobial to both Gram-negative and Gram-positive bacteria. Microbiologists have been testing the effectiveness of cinnamon and other spices in eliminating one of the most virulent bacterial causes of food poisoning *E. coli* O157. It is reported that cinnamon added to apple juice that had been contaminated with *E. coli* was able to kill 99.5% of the bacteria within 3 days at room temperature. Cinnamon, clove and garlic all had a powerful ability to stop the growth of bacteria in meat and sausages.
Recently, Cinnamon has also been evaluated in antimicrobial model meat system involving chicken meat. Incorporation of the alcoholic extract of cinnamon at 0.4% (w/w) level alone or in combination with *Lactobacillus acidophilus* (LA culture) in minced chicken meat exerted potent antimicrobial effect in controlling the growth of total aerobic bacteria by 1 to 2 log scale given in the Table 1 during refrigeration (4±1°C) storage. However, antimicrobial effect of combination of cinnamon extract and LA culture was more as compared to either of them alone. These are good antioxidant as indicated by lower thiobarbituric acid value in extract and LA culture treated group.

**Clove, Syzygium aromaticum** (Linn.) Merrill & Perry

Clove or *Laung* are the dried buds of the Clove tree, which contain 14-21% essential oil and 95% of it is eugenol. The herb keeps the food fresh, as the main active ingredient of clove is eugenol, which has long been known to kill bacteria and viruses. Incorporation of alcoholic clove extract at 0.15% w/w level alone or with LA culture in minced chicken meat exhibited potent antimicrobial effect during storage at refrigeration temperature. The antioxidative effect of either of these was evident from the fact that TBA values in clove extract or LA culture treated group remained lower as compared to untreated control group. The combination of both clove extract and LA culture doubled the shelf life of minced chicken meat up to 8 days as compared to 4 days shelf life of control group during storage at refrigeration temperature. Clove extract is reported to inhibit the growth of *Salmonella typhimurium* (Singh et al., 2004), *Aeromonas hydrophila* and toxin production by *E. coli* in model meat system involving chicken meat and meat products during refrigerated storage.

### Desirable microbial culture and/or their metabolites based preservatives

Some of bacteria or fungi produce proteins or protein based...
compound/metabolites, which possess antimicrobial properties. For example, nisin, a polypeptide produced from *Lactobacillus lactis*, inhibits *Clostridium botulinum* growth in pasteurized cheese spreads. Nisin can be purified and can be used for increasing shelf life of many dairy and meat products. Another product natamycin (pimaricin) is an antifungal agent produced by *Streptomyces natalensis*. The compound is effective against yeast and molds and can be used for preservation of meat products. Lactic acid bacteria can also be used for the preservation of poultry meat as they produce lactic acid, which lower the pH of meat, or meat product at which most of the spoilage bacteria generally do not grow. In addition, lactic acid bacteria also produce metabolites during their growth and these metabolites suppress the growth of other spoilage and pathogenic bacteria.

**Antimicrobial constituents of other foods as preservatives**

Some of the foods such as egg contains lysozyme, an enzyme derived from egg white, has a bacteriocidal effect on a wide range of spoilage bacteria. This has been recognized as GRAS (generally recognized as safe) for using as antimicrobial agent in meat and poultry products. It has also been found to check the growth of *Clostridium tyrobutyricum*. Another antimicrobial product is milk protein called lactoferrin, which plays important role in immune system and protect the body from many infections. In January 2002, USDA approved activated lactoferrin for use in fresh beef, providing beef processors with a potentially powerful technology to protect consumers from pathogenic bacteria. Another product obtained from freeze-dried egg yolk has been found to inhibit the growth of many microbes by binding with pathogens.

*Monascus purpureus*, a red mold species, which can be cultivated on starch containing substrates such as rice, and produces a product called fermentate. The main application of fermentate is its use as food additive in particular to meat as preservative. The antimicrobial effect of fermentate has been found against *Bacillus, Streptococcus* and *Pseudomonas*. In low concentration pigments from *Monascus purpureus* has been found to have bacteriostatic effect against *Bacillus subtilis* and *Staphylococcus aureus*. Pigment from *Monascus purpureus* strongly inhibits Gram-negative and Gram-positive bacteria and it can be used to replace nitrite for the preservation of poultry meat.

**Conclusion**

A number of compounds from natural sources possess antimicrobial and antioxidative properties for the preservation of nutritious and highly perishable meat and meat products. The concept of biopreservation or bioprotection of red meat including poultry meat is gaining importance in recent years. More thrust is given on the isolation, characterization, standardization of application levels and methods, of biopreservatives to evaluate their efficacy in extending the shelf life and improving microbial safety aspects of meat.

**References**


