ADVANTAGES & LIMITATIONS OF SPICES AND HERBS FOR PRESERVATION OF FOOD

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ABSTRACT: *Herbs and spices are having great attention in recent years for preservation of food in industries. Compounds of phenols play's an important role for antimicrobial growth that present in natural foods but it also have some questionable points regarding multiple intrinsic and extrinsic factors, that needed to be characterized before using spices and herbs as ingredient. The fact that leads high amount of concentration and extraction of plants for inhabitation of microbial growth and limit the growth of organoleptic compound. Similarly the synergistic interaction and use of different additives may lead in low concentration of antibacterial efficacy and enhance the use of herbs and spices and facilitate the industry for preservation of food.*

Key words : *In vitro and In-vivo* studies ,organoleptic compound, antibacterial efficacy, phenolic compounds,Quorum sensing.

INTRODUCTION

Shelf life and storage capacity of many foods are very limited and they need to be preserved for later usage and to maintain their exact state as well. Such as food items like cow meat, goat meat, chicken and mostly sea foods they easily breakdown from their original state and their pathogenic microbial activity is increased. With advancement in technologies and researches in the field of food preservation various methods and techniques being adapted to incorporate this microbial affect and develop an effective method to overcome the problem of dieses by the expertise. Various chemical and physical methods are used such as drying, using high preserve, electric and magnetic pulsed and lighting pulsed method, acidification and salting with continuous stirring is also adapted and on various accounts light treatment techniques such as ultraviolet treatments is also used. [1, 2]

Now a day's consumer's demand slightly preceded food material because they need food with lees additives and sometime slight addition of naturally occurring additives [3]

Antimicrobial substance which are naturally derived or obtained from soil using fossils or obtained from plant extraction, derived from tress and in some cases from minerals reserves are completely natural and non-organic which are labs made products. Above all these natural products plants are as friendly to human and as resourcefully as anything in this planet, civilizations over civilization relies on plants and their products in various activities such as protein's requirements handmade medications. And provide great source of supplements to people and provide benefits in every possible way. The major part these plants extract play's in food preservation is that they control the excessive growth of microorganisms through their antimicrobial control activity present naturally in them. [4]

The major characterizes of plants is their antimicrobial activity which is to synthesize via secondary metabolism and to go through complex structures of various chemical compounds through its antimicrobial ability. Advantage of this antimicrobial activity of plant is being boosted up during tough conditions and keeps them balance. [5,6].

The review provides an overview over the increasing demand for using plant derivate from spices & herbs as major source of antimicrobial agents used in foods alongside their challenges and potentials.

ADVANTAGES OF SPICES AND HERBS AS ANTIMICROBIAL AGENTS

Plants have a very large range of its derivative's and herbs and spices are among them and use of herbs and spices are not from today it is from the day that this universe is being created in order to maintain the balance between the food recipe and its shelf life and overcome the growth of antimicrobial activity in them, sometimes herbs and spices changes or fewer the effect of sugar and salt in the food when they being preserved. The main purpose of using herbs and spices is that they are categorized as safe {GRAS} and have many purposefully replicates to chemo-additive's. [7,8]. In different parts of the world they being recognized from different names bus it general they are obtained from green plants from leaves and steams. When we compared herbs and spices they differ according to the climate and temperatures zone as herbs grew in the temperature zone while spices grew in the tropical region. Whereas herbs are aromatic in nature and spices are extracted from seed, buds of flowers, berries & bark [9]

Originating from Mediterranean area herbs and spices can be found almost every part of the world but as mention above on these temperatures zones are its intimal requirement. [10].

Almost every herbs and spices have antimicrobial activity in them which fight against the microbial activity of bacteria and harmful viruses that spoils the effect of other material such as phytochemicals constituents of phenolic compounds. [11,12,13]. in various studies that have been previously reported suggested the correlation between antimicrobial sight and amount of phenolic component available in spices & herbs.[1]

In most of the plants the main contributor of the biological activity of plant is the volatile constituents present in spices & herbs is Oil. In general this volatile constitutes is chemically involved in more than seventy other compounds for example class of trepans is involved in herbs and spices , polyphenolicc compounds and in totality around 80% content is based on these volatile compounds present in herbs and spices . Oils like cavacrol, eugenol or aldehydic cinnamon which is being present in clove, thyme or in cinnamon identifies the substance in them which is effectively responsible for growth against microbial activity. [3,4,14] phenolic compounds in general have lipophilicity in them and that characteristics enhances its mode to be as active

participant for antimicrobial effect. this seems to be the advantage for the food preservation industries as reported by the researchers that lipophilicity in general cause functional and structural damage of microbes by penetrating their membrane and disturbing their osmotic nature of the cell. [15].

The above reaction inhibits the property of the cell and then causes them for the leakage into multiple substances for example nucleic acids, ions, amino acids and Atps. Furthermore the cell damage cause the pH level to be low because of oxygenation of fatty acids with in the cell bacteria because of this compound is being present hydro peroxidases. [16, 17,18].

While on the other side there is huge variety of substances like phenol's that being derived from spices & herbs have this differentiation among foods. They can inhibit the oxidative rancidity nature and can delay the process of changing the food flavor in different products [10].

The study shows that the herbs and spices have antioxidant activity as well which is due to their chemical structures and redox nature which is effective for neutralizing free moving radicals , quenching singlet's, chelating transitional metals & oxygen triplets by decomposing or may be some times delocalizing peroxides.[3] As pure compounds various phenolic compounds exhibit good antioxidant properties when used if foodstuff, on the other hand other constituents compounds depends on synergism which carry out protectiveness.

This is the reason to get that sort of compound which provides this type of extraction and has the same effects and at the same time this compound synergism has more research based opportunities' that can be an eye catching for the food industrialist, since spices and herbs have potential bio activity which protects the body from damaging affected by those free radicals which has stress causing oxidative materials and later on delaying the activity of these oxidative stress diseases resulting in heart diseases, diabetes, Alzheimer's and have carcinogenic effects[20,21]

The correlation between gut microbial and polyphenols is catching eye towards researchers which is also in corporation to provide helpful nutritional designs for food industries [22,23]

As in total when we consider species and herbs are the major contributor of total polyphenol intake and identifies as the 100th resourceful dietary showing polyphenolic spices & herbs with high amount of concentration.[24]

Cloves as a spice or Star Anise have large amount of phenolic flavor as eugenol as cloves and anethole as star anise. On the other hand herbs have also very rich source of flavonoids like peppermint or Mexican oregano and sometimes have high content of hydroxyl-cinnamon acid in herbs from the family of sage rosemary, thyme and spearmint. In most of the cases many polyphenols are being metabolized very intestinal micro biota resulting in metabolites of higher bio-activity compared to the predecessors. [23].

Now this research provides us with the demand to increase the knowledge towards polyphenols dietary from various sources of food.

PROCEDURES & TECHNIQUES TO DETERMINE ANTIMICROBIAL ACTIVITIES.

Getting the complete information regarding the antimicrobial activities of spices and herbs is not clearly understood often because the kind of mechanism they have in them due to several multiple chemical compounds present in them therefore specific attributes of these compounds present in them is not yet targeted by the fellow researchers inside their microbial cell.[7], now a days the recent study on natural products provide significant information of (-OH) phenolic groups which has inhibitory effect over these microorganisms which cause damage in preservation of food in multiple sectors. Due to this these compounds has adverse effect in terms of their toxicity at the highest of membrane penetration and has the significant effect of hydrophobicity at various compounds of phenol is being observed during research. [11]

Now the delocalization of electrons is because of the active groups present in them which are proton exchangers and minimize the gradient across cytoplasmic membrane of the bacteria. (k^+) efflux is the initial damage and then probably followed by cytoplasmic efflux constituent. Now various phenolic compounds like (carvacrol, thymol and eugenol) interact with the cell's phospholipid bilayer membrane and release K^+ & H^+ charge ions gradients followed by the leakage of cellular vital constituents of microbes such as nucleic acids, ions, amino acids showing level of water disturbance , decrees in concentration of intercellular ATP and eventually death of the cell.

Due to this the activity of the cell is greatly affected and the osmotic pressure of the cell is decreased significantly and solute route and metabolism is highly affected. With the increase of cytoplasmic permeable membrane the result is in the loss of cell's pH gradient, depletion in proton MF, decreased in the levels of ATP and allowing the cell to dye.

Simultaneously when the enzymatic system is disturbed cell damage is started because of the genetic materials present in bacteria, fatty acids being formed in the cell, hydroperoxidase formation, level of nutrient is decrease levels of ATP activity followed by nucleic acid synthesis [17].

Retardation in growth rate is because of the ATP intracellular decrease when its bacteria is being treated with spices and herbs resulting in loos of ATP synthesis or may be increased in its hydrolysis, on the other hand the extracellular ATP's level is significantly increased because outside leakage in intracellular ATP. The other reason may lead towards coagulating cytoplasmic materials and formation of different Meso like structures [15].

Talking about bacteria there are 2 classes which interact with spices and herbs i.e. Gram positive bacteria and Gram negative bacteria. On comparison between these two, gram positive bacteria was found more suspect able because they directly interact with the membrane cell of spices and herbs.

Gram +ve bacteria's (Listeria monocytogenes, Staphylococcus aureus Bacillus cereus).

Whereas Gram negative bacteria are less susceptible because their interaction with the membrane cell is less effective because lipopolysaccharide is outer membrane of the group which limits the compounds of phenol's to diffuse in the cell membrane

Gram -ve bacteria's (Salmonella enteritidis and Escherichia

coli) [25,26].

With the ongoing process of research on plant and its extraction with the interaction with microorganisms a mechanism is adapted by the researchers which is (QS) Quorum sensing , this mechanism enables the bacteria to take collective decision w.r.t its specific genes sets which is an influential virulence factors [27]

Quorum sensing (QS) mechanism regulates the pathogenesis bacteria by stimulating them disease causing attributes for example; formation of biofilms, secretion virulence factor and motility [28], The photochemical effect of spices and herbs is quiet less in that genes which is responsible for the interaction between bacterial pathogenesis system and they are being synthesized by the members of synthases of autoinducer bacter.[30,31]

The results showed up explaining that following compounds decrease the cell attachment to the growth of biofilms, attachments to polyvinylchloride (PVC) resulting in the decreased of metabolic activity [32].

In addition to the results garlic extract comes in handy because it limit the production of biofilms and hence supports the clearing of bacteria [33]

EFFECTIVENESS OF ANTIMICROBIAL ACTIVITY IN PRESERVATION OF FOOD.

In vitro study shows that spices and herbs components have impactful antimicrobial activity. Since when they are used in foods, they required very high amount then the levels are not always organoleptic ally accepted. [34-35]. Organoleptic activity of foods are being preserved by using a combination of plants extract, herbs and spices because oils have very high aroma at about very low concentration. [15-36].

Many researches have been made on *In Vitro* studies to enumerate the activity of anti-microbes for food preservation but when plant extracts compared with pure compounds plant extracts doesn't have much significance [11].

Explanation regarding the differences may be because the run tests shows the presence of fats, protein's, carbohydrates, salt content and levels of pH and their influence may interrupt the sensitivity of food because of bacterial growth [12, 37, 38]

For food preservation, the availability of nutrients is in large quantity when compared with amount of quantity present in laboratory, can lead towards the repairing of the bacterial cell. The repair of this bacterial growth against attributes of very high levels of fats and proteins present in foodstuff [25].

Table 1 shows some relevant information regarding antimicrobials activity of spices and herbs and their respective extract.

Environment and temperature for storage of food material also play an important part in the effectiveness of antimicrobial activity because diffusibility of various compounds are related with each other. On processing the food materials which containing phytochemicals it may result in slight change in their content [39]. The phytochemical content in foods is vanishes by heat processing like sterilization , dehydration and pasteurization and in some cases processing involves novel compounds formation that either increase's or maintain the multiples extracts. While polyphenols and presence of antioxidants in food layer provide assist to compounds of polyphenols [11].

Microencapsulation technologies now a days are considered good alternative to enhance the stability verses environmental factors [40, 41].

While chemical variability of spices and herbs and important oils on the account of their environmental and geographical conditions, plant's age, extraction and harvesting methodology are few important issues of their applications as natural foodstuff preservation [42,43]

Now let's look into the matter of their limitations in food preservation. Spices and herbs are being harvested in natural environment and the kind of method and its distribution technique may lead towards human pathogens because of their microfloura and different harmful microorganisms [44]. Some times when these spices and herbs are used for food preservation or when they are being used for eating purposes they need to be well cooked so that their harmful pathogens gets easily removed out while heating. Sometimes a risk is involved in food poisoning because certain parameters are omitted like cooling, temperatures conditions and store seasoned food with herbs and spices. [45,46]. Gamma radiation upon 10kGy found feasible for disinfection techniques for spices and herbs. [44]

Table 1 Inhibitory effects of spices and herbs as antimicrobial agents for food preservations.[4,34,37]

Kind of food	Micro organisms	Herbs & Spices	Effects
Apple juice	Listeria monocytogenes	Cinnamon powder	✓
Chicken	Listeria monocytogenes Aeromonas hydrophila	Eugenol	✓
Ground beef	Natural microflora	Fresh garlic paste	✗
Chicken	Increase shelf life	Oregano (with modified-atmosphere packing)	✓
Mozzarella cheese	Listeria monocytogenes	Clove oil	✓
Chicken	Bacillus cereus Staphylococcus aureus,	Sage oil	✗
Eggplant salad	E.coli O157:H7	Oregano oil	✓
Strawberry puree	Natural microflora, yeast	Vanillin	✓
Carrots	E.coli O157:H7	Thyme oi	✓
Cod's roe salad	Salmonella enteritidis	Mint oil	✓

Pate	Listeria monocytogenes, Salmonella enteritidis	Mint oil	
Meat	Listeria monocytogenes	Clove oil, eugenol and coriander, oregano,	
Salmon fillets	Photobacterium phosphoreum	Oregano oil	
Boiled rice	Natural flora	Carvacrol	
Fresh pork sausages	Listeria monocytogenes	Rosemary	

CONCLUSION

In vitro studies of spices and herbs are explained in quiet depth but still there are factors that needed to be taken care of before using directly for food preservation because levels of phytochemicals vary in plants due to their condition of climate and harvesting techniques. Therefore it is off top priority to consider organoleptic effect and to have adequate knowledge of using these naturally based preservatives which can change the taste of food material. Microbial activity of food with other ingredients may differ and this has to be directly control because growth of microbial assay is very harmful. This method of preservation on food by using spices and herbs can be useful when proper conditions are being applied under supervision and correct extract of plant is chosen so that microbial growth can be contaminated

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