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# Traditional, Alternative & Solar Drying methods for producing spices: A Review

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**Abstract -** *For farmers, producers, and consumers, conventional spice production involves a variety of hygiene issues that can be extremely dangerous. Moreover, a good diet significantly impacted as well. There are just a few conventional processes for cleaning spices, but some of their uses, like ethylene oxide fumigation, are regulated or even prohibited by EU law. The creation of novel technology is therefore required for the manufacturing of premium spices. The main issues with traditional spice production are outlined in this article, along with a summary of recent developments in alternative methods.*

***Key Words***: Red Chilli, Processing, Solar Drying , Storage .

## 1. INTRODUCTION

Spices and herbs have been utilized for medical and cosmetic purposes as well as flavoring and food preservation since antiquity. The off-flavor or rotting of some foodstuffs was even disguised using spices in some instances. They used to be very sought-after and frequently compared to gold and precious stones. There is a huge demand for spices today, although they are no longer considered luxury goods. Their significance is still expanding. The amount of spices imported globally climbed steadily from 209,293 tons in 2000 to 226,910 tons in 2004, for a trade value of 625 million US dollars (FAOSTAT, 2005) [1-4]. India is the world's greatest producer and exporter of spices, chiefly pepper. Other top producers and exporters of spices include Capsicum fruits, turmeric, ginger, cardamom, seed spices, curry powders, and spice oils and oleoresins. Due to the fact that they are natural products, spices and herbs could include a variety of microorganisms, including some pathogenic species. Spices are non-perishable goods due to their low moisture content, but once they come into touch with foods that are high in water, microbial populations may swiftly grow. Particular when adding spices to prepared foods that have not undergone additional heat treatments, care must be used. European nations in various countries, the number of food-borne illnesses and spice-related intoxications has increased throughout the last decade of the 20th century. A significant food-borne disease in particular is salmonellosis. Germany experienced a widespread salmonellosis outbreak between April and September 1993, which was linked to tainted paprika and paprika-dusted potato chips. Along with the estimated 1000 cases of disease resulted in enormous financial losses and catastrophic reputational damage for the organization, demonstrating the necessity of good production practices to increase the overall and in particular the hygienic value of the raw materials and the goods developed therefrom. Several prior publications have already addressed the production of different kinds of ingredients in various areas of the world, elements of microbiological contamination, as well as sanitation technology [5-13].

### 1.1 CONVENTIONAL SPICE PRODUCTION

Spices are made from a wide range of plant parts, including rhizomes, barks, leaves, fruits, seeds, etc. Processing techniques vary to some extent and call for specialized knowledge in various activities because of the raw materials strong variability. These are frequently used to describe the bulk of spices, high are covered in the following. However, there are a few fundamentals to keep in mind [14-20].

### 1.2 Freshly harvested or partly dried (on the plant) raw material.

**Conventional process for the production of spices (steps indotted lines are optional)**

- ⇒ **Preliminary Treatment**
- ⇒ **Parching**
- ⇒ **Remove dirt**
- ⇒ **Crush**
- ⇒ **Fill up/Ware House**
- ⇒ **Microorganism Depollution**

## 2. Crop and after picking treatments

Growing techniques and raw material ripeness level, as well as other variables like climate, are crucial aspects for the manufacture of high grade seasonings. Human or automated harvesting is done, or ought to be carried out when the amount of effective substances is greatest [21, 22]

Various reply practices, including curing and pounding of capsicum fruits, are used before drying in order to enhance

color characteristics, reduce transit and storage volume, and quicken the drying process. Additionally, per acetic acid fogging and other chemical processes using hypochlorite, sulphur, and hydrogen In cardamom and ginger, peroxide is sometimes used to enhance color qualities and manage microbiological & pest problems. However, inside the European Union, many procedures are no longer used, are constrained, or even illegal. The sun drying of chilies is shown in Fig. 1.

Fig. 1: Sun-drying of chilies (Source: Chef Mandeep Singh)

Cosmological technologies are a promising new high technology that is becoming more and more significant for the dehydration of seasonings because mechanical drying is primarily utilized in industrialized nations as well as is not relevant to tiny family farms in rising nations [23-36]. Direct sunlight is still the most common approach, despite the limited availability of solar or artificial dryers (Fig. 2).

Fig. 2 Solar-drying of chilies (Source: Chef Mandeep Singh)

The taste ingredients are preserved most effectively at the temperatures lower. Cryogenic milling also offers other benefits. Compared to traditional grinding methods, which are detailed by Pruthi (1980) and not considered in this study. Although Freezer milling is region in industrialized countries, its use is constrained by the high expense of the potential for further development [27-30].

**Packaging and storage**

The spices are typically held for one to 90 days post manufacturing, before even being distributed to the merchants or the processing sector. In addition to the drying process, storeroom is a different crucial control point, and maintaining, right humidity and heat levels is essential to preventing harm to the spice material [31].

**Microbial decontamination**

The shelf-life of finished meals can be significantly shortened by spice compounds, which are used in almost all food products in various European and non-European nations are advised to avoid pollution (DGHM, 2006; ICMSF, 1986).As a result, a number of cleaning strategies have been created to lower the microbial burdens of seasonings [32].

**The use of ethylene oxide for fumigation**

When exposed to atmospheric circumstances, ethane quickly interacts to salt while dissipating from fumigated goods & to produce the mutagenic and cancerous compounds, and bromide.

Due to their higher persistence than that of the immense effect, 2-chloroethanol and 2-bromoethanol. As a result, the European Union forbids the utilization of ethane for insecticide. Moreover, owing to the low power required to extract the sanitation chemical, volatile chemicals are destroyed in addition to scent and color changes. It's been demonstrated that ethane dramatically lowers the bacterial load [33-39].

**Irradiation**

It has recently been demonstrated that radiotherapy, including the use of electromagnetic waves, electron beams, and X-rays, is a successful way for spice disinfection. Sections of 3e10 kGy

Improved the microbiological safety of spices goods and was proven to just be trustworthy.

Dried Fragrant herbs, ingredient or vegetable condiments may be irradiated with only a maximal total average consumed doses of ten kg to decontamination them. Despite being a productive, energy-saving, ecofriendly, and maybe even permitted technique, ionizing irradiation is seldom used because of weak social acceptability. Small alterations in tactile and antioxidant skills were also discovered. Additionally, irradiating ingredients are commonly packaged to protect secondary bacterial growth factors that potentially or non-volatile low volume radiologists goods that are released from of the packing. These could be dangerous or could cause food poisoning, affecting the flavor [40]

**Steam treatments**

The usage of steam distillation is widespread in the European seasoning sector as ethylene oxide use has been outlawed and radiotherapy really hasn't gained favor with buyers. When using this method, entire seasonings are often steamed at a hot altitude before even being ground. Post pretreatment, it is necessary to wipe away any moisture that has collected just on surface of nanoparticles to stop fungus formation.

That makes the implementation of this method challenging, especially when used on ground spices, where a successful disinfection is connected with discolor or a decrease in essential oils levels [41-47]

**High hydrostatic pressure**

Vegetables or Fruit Products can benefit from administering high hydrostatic forces of Hundred to Thousand MPa since they are store shelves and microbial contamination acceptable. But on the other hand, water action is crucial for the deactivation of microbes. Savory flavor collections and moisture content under 0.66 did not reveal a decrease in the amount of microbes present. Problems associated with spice production (Aflatoxin pollution and greater bacterial rates). The warm and humid weather, the straightforward, unsophisticated operational circumstances, and lengthy humidity, or frequently insufficient directions from the farm owners result in significant sanitary and purity difficulties or may result in losses of up to 50percentage points of the yield. Since seasonings are exposed to pests like mice, pigeons, and mosquitoes as well as pollutants like flue gas, heating and radiation from the sun are special things that are most significant in the development of spices. Depending on the stems and leaves utilized, their origin, or the ecological, harvested, handled, stockpiled, and transit scenarios, considerable tiny numbers in the raw resources of up to 108 colonization power units/g may also be discovered. The bulk of germs are microbe, mesophilic bacteria, fungi, and yeasts. These organisms also contain dangerous and vegetal taxa as Pathogen, Coli, Bacillus, Listeria, and Staphylococcus. Due to their capacity to produce aflatoxin, fungus development mostly affects the production of paprika, chiles, cilantro, mace, Gingembre, and Safran des Indes ginger. Various aflatoxins have indeed been labeled as excitotoxic, transgenic, and cancer genic in addition to their acute toxicity [48-51]. Globally regulations govern the limit value aflatoxin levels in food and feed. The fumonisins in particular exhibit great high thermal stability. In order to avoid and early suppress growth of microorganisms and lower the risk of aflatoxin generation, the administration of fungicides during blossoming and the quick parboil of the raw resources are the best effective methods.

**Losses of valuable compounds due to endogenous enzyme activities**

The body naturally of the plant products continues post-yield, so oxidation enzymes are extremely active at this period. This is in additional to microbes. Some of these alterations include moisture loss, lost opportunities for scent and color, calming, and breakdown. Evaporation reduces the water potential, which limits but does not completely inactivate the enzymes' action. The enzyme's activity resumes after food products are rehydrated and when spices are stored moistly. This could have a negative impact on the coloring, aroma, and texture of spices as well as food stuffs as a whole. In order to produce superior seasonings, spoilage organism's enzymes must be completely and immediately inactivated [52-55].

**Losses of valuable compounds due to conventional processing and storage**

Other than the essential elements being degraded with the help of enzymes, aroma and flavor chemicals, which are relatively constant in the whole plant cells, grow hypersensitive while treatment and storage. In specifically, static friction generated during in the milling accelerates coloration and high oil degradation from evaporating or oxidizing processes. Among the numerous factors that change the genuine impressions of events include air, environments that encourage oxidation, sunlight, and extreme temperatures. The lack of chemical reactivity in preserved dried seasoning products is indeed a big commercial problem so because goods take a long time to approach the buyer.

**Innovative spice processing**

Different techniques for producing spices also have previously been devised, minimizing the fore mentioned drawbacks or issues associated traditional seasoning processing.

**Spice oils and oleoresins**

In the past, people have prepared food using spice blends.

Food delights have been improved through the use of hydro distillation by food technologists to recreate the fragrance of seasonings. The essential oils, which are concentrated forms of the aromatic elements. Parallel to something like this, the exploitation of the ground spices and subsequent drying of the solution led to the production of vividly colored, liquid oil that included both the concentration volatile flavoring compounds and the specific aromatic attributes of the seasoning, like the pungent elements of ginger and chilly. Spice oils and oils have proven to be a successful option for food flavorings in terms of hygiene problems, however both set of techniques are very vulnerable to sunlight, temperature, and oxygen and demonstrate poor storage stability. To stop the degradation of necessary[56-58]

**Alternative process for the production of spice powders**

Recent times, a brand-new method for producing premium spices was created. Deteriorating components can be instantly heat inactivated thx to the novel approach. Social media also play a significant role in this field

The incorporation of enzyme and bacteria in farm fresh raw materials has been shown to be essential for producing spice commodities with top standard and sanitary status; early fungus prevention reduces mycotoxin generation. To

illustrate the usefulness of this strategy, green pepper, coriander, chilli, and other plant sections at various stages of development were selected. After being gathered, the mass production was promptly blanched, made into the paste, and dehydrate. Instead, mincing was used before the heat treatment. The processing techniques are typically changed. The preparation techniques employed are typically adapted again from food business, which makes it easier to innovate this technique and execute it in underdeveloped nations. The goods were often distinguished by much less bacterial burdens than traditional ingredients. The residual search term, peroxide, and polyphenol oxidase activity found in red and chilli goods showed that spoilage organism's enzymes had been inactivated because the spice powders displayed vibrant hues that were especially noticeable in green pepper powder. These ingredients may also be used to avoid altering delicate foods like processed meat or quick soups in terms of their taste and textural aspects. Unavoidable volatile oil evaporation did not appear to be impacted by the temperatures or time frames tested. Consequently, these reductions were primarily attributable to the ultimate pasteurization rather than the initial heat processing.

**Future research activities**

Among the food manufacturing processes with the highest increase in recent years is extrusion. Because to the decrease in bacterial loads, aflatoxin pollution is avoided. Unique offering enhances the security and grade of finished and intermediate goods through suppression of enzymatic degradation. Numerous invention filings that mention this ground-breaking method for cleaning spices already exist. To the greatest of our knowledge, however, its application in the spice processing business has yet to be proven, as well as no published studies that show how well the quality of spices might be improved. Covid 19 also play a role and impact on economic loss

**Optimization of the alternative process for the production of spice powders**

Given that the innovative production process detailed under this study was not able to stop the degradation of volatile oils, future research should look into alternate drying methods to improve the protection of volatile compounds. The evaporating substances could be collected and then added back as a different tactic. The alternate method, after adjustment, complies with complete food security. Programs with GAP, GMP, and HACCP components that is appropriate for making spice powders with low bacterial loads, vivid colors, and high levels of flavoring compounds (Chandel et al. 2016). Future manufacture of unique, hygienically sound spice goods with a diversity of sensory attributes is also made possible by manufacturing various plant parts or plucking at various stages of maturity.

**Enzyme-assisted liquefaction of spice materials**

Another novel method in spice production involves the use of cellular membranes dissolving enzymes. Plant tissue acid hydrolysis is used for a variety of objectives, including improving juice yields, stimulating secondary metabolite release in plants to recover important food components, and skinning. Acid hydrolysis of cell membranes could be utilized as a substitute to chilly grinding, which is both costly and technically challenging. Artifical intelligence also useful in this field [21].

## CONCLUSION

Despite the fact that spices have been used through centuries, little advancement has taken place in spice manufacturing. To create easy, healthy, and secure products with improved shelf life, breeder, growers, dieticians, and marketers must work together closely. Overall quality of latest techniques and items will eventually be determined by buyer approval, which itself is regarded as the most important issue. Because the innovative procedure provided in this study's processing techniques is well developed in the food industry, the items created are quite likely to gain approval by customers. Secondly, novel procedures can make a significant contribution to Hazards analysis critical control point ideas in the food business. They serve as a foundation for future research investigations and efforts to reduce the incidence of food-borne illness spread by ingredients, so ensuring food security.

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