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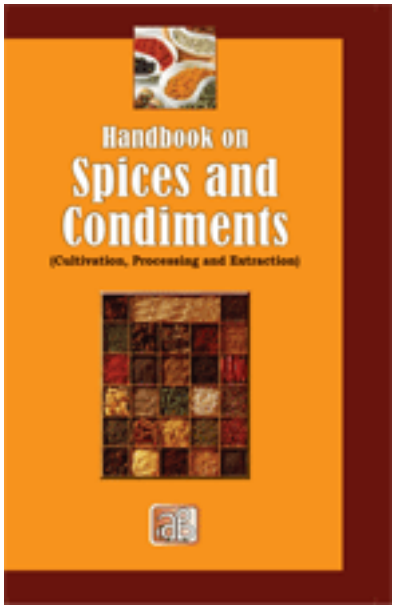
Handbook on Spices and Condiments (Cultivation, Processing and Extraction)



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The term Spice and Condiments applies to natural plant or vegetable products or mixtures in whole or ground form, which are used for imparting flavour, aroma and piquancy to the food items. Spices and condiments are a major commercial crop in India, and earn a major part of foreign exchange annually. They have been the backbone of agricultural industry. The importance of spices and condiment in dietary, medicinal and other uses, and their commercial importance are immense. India is known the world over as the home of spices. Thus spices are an important group of agricultural goods, which are virtually indispensable in the culinary art. Spice processing includes different steps: spice cleaning, spice reconditioning and spice grinding. Some spices were also used for preserving food like meat for a year or more without refrigeration. In the 16th century cloves for instance were among the spices used to preserve food without refrigeration. Cloves contain a chemical called eugenol that inhibits the growth of bacteria. It is a natural antibiotic. It is still used to preserve food like Virginia Ham. Likewise later mustard and ground mustard were also found to have preservative qualities. India alone contributes 25 30 % of the total world trade in spices. It may be interesting to note that nine spices namely pepper ginger clove cinnamon cassia mace nutmeg pimento (allspice) and cardamom alone contributed as much as 90% of the total world trade. Pepper is the most important spice in the world and so also of India.
This book basically deals with brief history of spices, uses of spices, world trade in spices area & production of spices in India, area and production of spices in India, major and minor spices of India, spice processing, quality issues with spices, bird chillies and Tabasco chillies, basil or sweet basil, seasoning blend duplication and tricks, sauces and gravies, snack seasonings, quality issues with spices, etc.

This book is a single compendium which deals with all aspects and facts of spices and condiments which may meet the requirements of all those handling them at various stages, from harvesting to their end use. This book contains post harvest management, the potentials of genetic engineering, high production technology in spices with plantation and processing of various spices and condiments such as vanilla, turmeric, tamarind, saffron, black pepper, onion, mint, ginger, garlic, curry leaf, coriander etc.

Tags

Agro Based Small Scale Industries Projects, Agro-processing of spices, book on spices, Cultivation of spices and condiments, Cultivation of various Spices in India, Extraction of Oleoresins & Essential Oils, Food Processing & Agro Based Profitable Projects, Food Processing Industry in India, How to extract oil from spices, How to grow spices from seeds, How to Process Spice, How to Start a Food Production Business, How to Start a Spices Production Business, How to Start Spices Processing Industry in India, How to Start Food Processing Industry in India, Importance of spices in our life, Most Profitable Food Processing Business Ideas, Most Profitable Spices Processing Business Ideas, new small scale ideas in Spices processing industry, Processing of spices and condiments, Processing of Spices and Plantation Crops, Production Technology of Spices, Profitable Spices to Grow, Small Scale Food Processing Projects, Small-scale spice processing, Spice production process, Spices and condiments and their uses, Spices and condiments pdf, Spices and Condiments: processing grading and Value added products, Spices Processing Industry in India, Starting a Food or Beverage Processing Business, Starting a Spices Processing Business, Steam Distillation of Spices

Content:

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Introduction

Spices and condiments need no introduction since India is known the world over as The Home of Spices. Spices constitute an important group of agricultural commodities which are virtually indispensable in the culinary art. They also play a significant role in our national economy and so also in the national economies of several spice producing exporting and importing countries. For instance during the year 1996 97 India earned foreign exchange to the tune of over Rs. 1180 crores through the export of about 219 400 mt of different spices Table 1. Besides huge quantities of spices are also being consumed within the country for flavouring foods and are also used in medicine pharmaceutical perfumery cosmetics and several other industries.

According to the International Organisation for Standardisation (ISO) there is no clear cut division between spices and condiments and as such they have been clubbed together. The term spices and condiments applies to such natural plant or vegetable products or mixtures thereof in whole or ground form as are used for imparting flavour aroma and piquancy to and for seasoning of foods .

There are over 80 spices grown in different parts of the world and 50 spices are grown in India. Spices may comprise different plant components or parts such as

Spices are well known as appetisers and are considered essential in the culinary art all over the world. They add tang and flavour to otherwise insipid foods. Some of them also possess antioxidant properties while others are used as preservatives in some foods like pickles and chutneys etc. Some spices also possess strong antimicrobial and antibiotic activities. Many of them possess medicinal properties and have a profound effect on human health since they affect many functional processes. For instance spices intensify salivary flow and the secretion of amylase neuraminic acid and hexosamines. They favour the cleansing of the oral cavity from food adhesion and bacteria they help to check infection and caries and protect the mucous membrane against thermic mechanical and chemical irritation. Spices increase the secretion of saliva rich in ptyalin which facilitates starch digestion in the stomach rendering the meals which are rich in carbohydrates more digestible. Spices possibly activate the adreno cortical function and fortify resistance and physical capacity. Stroke volume blood pressure and stroke frequency can be markedly diminished or augmented by means of spices. The significance of these possibilities is evident with regard to the ailing on the one hand and to the performance conscious sportsman on the other. Spices inhibit thrombus formation and accelerate thrombolysis. All these important physiological and medicinal aspects of spices and condiments deserve our serious consideration and further thorough probe wherever necessary.

Brief History of Spices

The fame of Indian spices is older than the recorded history. Centuries before Greece and Rome had their birth sailing ships were carrying to Mesopotamia Arabia and Egypt the Indian spices perfumes and fine textiles. It was the lure of these spices that brought many seafarers to the shores of India.

Long before the Chiristian era the Greek merchants thronged the markets of South India buying spices among other precious things. Epicurean Rome was spending a fortune on Indian spices silks brocades and cloth of gold etc. The Parthian wars are believed to have been fought by Rome largely to keep open the trade route to India. It is also said that there might have been no crusades and no expeditions to the East without the lure of India s spices and her other famed products.

Today when spices cost so little it seems unbelievable that they were once a royal luxury and those men were willing to risk their lives in quest of them. It was in the year 1492 that Christopher Columbus discovered the New World. Five years later four tiny ships sailed southward from the port of Lisbon Portugal under the guidance of Captain Vasco Da Gama. Like Columbus Vasco Da Gama too was searching for a

new route to the spice lands of Asia. While Columbus failed to achieve that goal Da Gama succeeded. In a two year 24 000 mile round trip he took his ships around the continent of Africa to India and back to Lisbon. Only two of the four ships survived to reach their homeport. These two ships brought back a cargo of spices and other products worth 60 times the cost of the said voyage!

The spices of the East were valuable in Da Gama s time as they had been for centuries because they could be used to stretch Europe s inadequate supply of food. During these Midddle Ages a pound of ginger was worth a sheep a pound of mace worth three sheep or half a cow! Pepper the most valuable spice of all was counted out in individual peppercorns and a sack of pepper was said to be worth a man s life! Vasco Da Gama s successful voyage intensified an international power struggle for control over the spice trade. For three centuries afterward the nations of Western Europe Portugal Spain France Holland and Great Britain fought bloody sea was over the spice producing colonies.

In a nutshell the fascinating history of spices is a story of adventure exploration conquest and fierce naval rivalry!

Uses of Spices

The people of those times used spices as we do today to enhance or vary the flavours of their foods. Spices were also flavour disguisers masking the taste of the tainted food that was still nutritious but would if unspiced have to be thrown away. Some spices were also used for preserving food like meat for a year or more without refrigeration! In the 16th century cloves for instance were among the spices used to preserve food without refrigeration. Cloves contain a chemical called eugenol that inhibits the growth of bacteria. It is a natural antibiotic. It is still used to preserve food like Virginia Ham. Likewise later mustard and ground mustard were also found to have preservative qualities. When spices were not available people often went hungry because they could not preserve their food for the winter. Such was the economic importance of spices in those days.

World Trade in Spices Area & Production of Spices in India

India alone contributes 25 30 % of the total world trade in spices. It may be interesting to note that nine spices namely pepper ginger clove cinnamon cassia mace nutmeg pimento (allspice) and cardamom alone contributed as much as 90% of the total world trade. Pepper is the most important spice in the world and so also of India. Among the importing countries USA is the largest importer of spices. Several other countries like Australia Britain Canada Russia and some European countries also import spices.

Area and Production of Spices in India

About 50 spices are grown in India as compared to 86 in the world. Out of these about 20 25 are commercially cultivated in different states of India. The recent available published information on area and production of 15 important spices is summed up in Table 1 as under

In India the major spices grown are pepper cardamom (small and large) ginger turmeric and chillies. Pepper is the most important spice of India rightly termed as the King of spices and is also known as black gold of India . Corresponding higher figures can be seen from Fig. 1. Thus though spice crops are cultivated in comparatively small units as compared to food crops they contribute a sizeable share in the international trade.

Major and Minor Spices of India

As stated above there are five major spices namely black pepper (the most important spice of India and also of the world) capsicum/chillies ginger turmeric and cardamom (small and large). Together they contribute 65 to 85% of the total foreign exchange earnings from all spices.

Important minor spices grown in India are ajowan aniseed caraway celery seed coriander cumin dill seed fennel fenugreek garlic onion saffron and vanilla etc. Unfortunately no reliable statistics are available on the total area and production of minor spices in different states of India. All these major and minor spices are

discussed individually in respect of their nomenclature (for the purpose of their proper identification) brief description distribution composition and economic utilisation.

Individually spices could be classified or grouped according to different systems of classification such as according to their (a) botanical analogies or families (b) economic importance viz major and minor spices (c) similarity in methods of cultivation (d) similarity in plant parts or components such as seedy spices leafy spices bulbous spices rhizomes and roots etc. But each system has its own merits and demerits. Space does not permit in this short handbook to go into such technicalities. For simplicity and convenience of reference the spices have been discussed one by one in an alphabetical order irrespective of the above considerations. Of course effort has been made to record the latest correct nomenclature and family to which each spice belongs along with their popular English names as well as their names in Indian languages. By no means is this first popular Indian book considered exhaustive or complete in all aspects. For instance agronomical or cultivation aspects basic chemical microbiological and technological aspects etc. for the obvious reason of being too technical are outside the scope of this handbook.

It is the purpose of this compendium to compile collate categorise and condense the available published information found scattered in different foreign and Indian magazines/ books bulletins reports and standard reference works which are not easily available to the educated layman. It is also intended to highlight the economic importance of spices and the tremendous role they play in human health about which the layman may not be fully aware. It is also proposed to stress the importance of further researches on the precise effects of different spices on different human systems viz. digestion respiration circulatory and nervous systems etc.

It is earnestly hoped that this humble attempt in bringing out a handbook on spices though belated will fill the gap adequately.

Export of Value added Spice Products (Spice Oleoresins & Essential Oils)

The demand for spice oleoresins is increasing as they offer certain advantages over natural whole or ground spices such as consistency in quality freedom from microorganisms uniform dispersion of the product and easy handling and saving in storage space etc. USA is the major importer and consumer of oleoresins. ITC has estimated that USA accounts for an estimated 50% of the total world oleoresin consumption. UK and Germany are the other major importers of oleoresins.

India s export of spice oils & oleoresins has shown remarkable growth in the last decade. Export has increased from 162 mt to 879 mt and the foreign exchange earnings from Rs. 2.66 crores to Rs. 69 crores in 1993 and over Rs. 260 crores during 1996 97. An annual average growth rate of 20% in quantity and 31% in value has been achieved in this period. Pepper oil & oleoresin constitute a major share of total spice oils and oleoresins exported from India. The oleoresins of capsicum chilli ginger turmeric and celery seed are the other important items (Table 3). Our major export markets are USA Germany and UK.

The exports of over 20 individual spice oleoresins as well as essential oils both in terms of quantum and value are depicted in Tables 3 & 4 respectively in the descending order of foreign exchange earnings for both the categories of products. The trend in the export of the two commodities collectively during the past 15 years is illustrated in showing the tremendous progress made (over 35 times that in the late seventies). The CFTRI scientists who have perfected the techniques have successfully achieved the technology transfer to a number of spice processing industries both in India and abroad some of them ever as turnkey jobs too.

High Production Technology in Spices

There is no field of scientific research in which workers can afford to ignore the importance of research carried through thesis dissertations and other research projects both ad hoc and permanent nature as a

source of information financed by central/state Govt. Private orgationisations and NGOs from time to time. These may be available through translation pamphlets bulletins etc. Patents are descriptions of inventions and have the effect of granting the patent holder the exclusive license to produce distribute and sell the invented item. Patent documents thus constitute a record of the original outcome of original research and development work in spice crops. In addition proceedings of conferences congress etc. have their own kind of importance as media for discriminating the results of scientific research of all the spice crops. Publications of conference proceedings will sometimes include transcripts of discussion at the block/regional state national and international level after each session. Some conference papers are specially designed to stimulate discussion or to suggest future lines of research in each or group of spices or aspect which might be productive in pocket or area. These programmes take place annually six monthly and becomes base for the future years in a well planned way. The research projects which are need based on the local problems and are discussed at length before these are executed in various centers or designated centers. Moreover outstanding figures of scientists of repute in a scientific research field are/will be invited to deliver the special lecture on the states of the art in their own areas of research in a specialized way.

Therefore researchers in developing countries are becoming more aware and conscious of the need to transfer part of the research activities from the experimental stations or laboratories in all the SAUs ICAR/IARI institutions Military Farms NGOs private companies various Boards and other organizations engaged in the Spice Industry to transmit the spice technology to the farmers fields. This awareness has resulted from the realization of the phenomenon of yield gap of the spices inspite of massive efforts of research carried out in research institutions and their satellite stations. Even though high spice crop yields were obtained in most of the trials conducted in experimental stations in the recent years the same could not be realized in more diverse and actual farming situations where these spice crops are grown in the country. The experience of various research and production organizations involved in evolving the better varieties through breeding production and seed production their commercialization post harvest management and added value improvement has not made much headway for various reasons. From time to time at the central and state level various boards and other organizations have joined hands to make developments in planned way and systematic manner by way of different long and short term projects being sanctioned and financed by the Govt. through various agencies banks etc. In this regard an interdisciplinary team of scientists at the center and state level chalked out a new strategy of laying out of research trials on selected components of high production technology in farmers fields and for validating the findings under real field situations at least in all the main and sub centers in the country under the aegis of Spice Board. The main strategy should be for the speedy dissemination of developed technologies which in anticipation confirmed through research cum demonstration plots conducted on SAU s Agri./Hort. Deptt. or on the progressive farmers fields and others in their selected fields. Therefore the status of information and knowledge gathered from such field trials will not only help the scientific community but will also help in enriching the practical knowledge of the selected farmers which will act as source of inspiration for farmers and also act as nodal agent for the spread of the developed technology. Thus it becomes of utmost importance to examine the rational behind on farm research strategy from a managerial perspective.

The on farm trial research carried out on experimental stations seems to be more realistic because the trials are laid out under controlled conditions. But on the other hand the on farm method the research is attempted in locations where the results are to be adopted by the masses. The results of such researches are manifested in a situation where there is diverse interaction between ecological social and economic factors the farmers are faced with. How far it is justified is not known. Further the very formulation of gather research problems/objectives should be based on the local needs/problems of the farmers of a particular situation. Under more or less centralized set up of experimental stations the formulation of collected data of

proposed research agenda is often based on theoretical academic consideration of highly qualified researchers or on the feedback the scientists receive from intervention agencies. But on farm research provides the scientist (s) in opportunity for gaining first hand knowledge of farmers actual needs and practical problems based on which he can plan formulate implement and follow of his research project on sound footing for conclusive results which will be of beneficial use to the farmers and others engaged in spice industry.

Now the participation of farmers has become a dire necessity to take up part a planning organizing executing and implementing the conclusive research programmes more effectively and this should be acceptable to the farmers in principle regarding spice crops. In practice formal meetings are expected to provide a forum among the scientists growers and others. Only presence of growers in such meetings does not mean appropriate participation. However in the present top down approach of research the growers are considered as the passive recipients of a package of practices developed by a research system. Normally growers not aware of where how and what of research on spice crops. The exposure to such research information generated will only lead to a psychological dissonance for the farmers who are active information seekers. Thus the farmers fail to evaluate the very rationale of the improved spice technology advocated to them. Now it has to be realized that involvement of the farmers in the very process of reseanch/ experimental work has got considerable psychological value in the moderationisation process. The integration of formal and informal research carried at the farmers level and also at different regions at various research units has got a special significance. Some of the progressive farmers understand the utility of the improved techniques which he has to conduct at his fields to know the authenticity of the proposed programmes. Therefore the notion that the farmers are also researchers is being slowly accepted. The farmers now a days knew that the proposed programme is of utility or not and accordingly he accepts and follows. Moreover farmers have developed many indigenous techniques which have been tried by generations and validated through their practical experience. This process is called informal research. On farm research by virtue of closeness of the researchers to the land he can attempt to learn from the farmers and try to integrate their informal research into the continuing process of formal technology development.

The feasibility of research conducted will be better known on the manner it is implemented and adopted by the farmers in fullproof way. Once the farmer comes across an innovation he tries to evaluate it under his situations in terms of its relative advantage and compatibility with his system. Before adopting it the farmer tries out the innovation on a small scale in order to observe its results. In case of existing formal research process the innovation evaluation by the farmer takes place only at a later stage only when the entire process of research on spice crops is over. But when the research is carried out in farmers fields the feasibility of adoption of any finding is determined early in the testing process because of the early involvement of the progressive farmers. The approach also shortens the time for the flow of information from research scientist (s) to farmers and vice versa.

Potentials of Biotechnology in Improvement in Spice Crops

Natural or artificially created genetic variability is a sine qua non for making selection an earliest and a potential suo moto methodology of plant breeding for varietal improvement. For the sake of applying selection for better yielding genotypes genetic variabilities have been created by a gamut of breeding activities like artificial hybridization induced mutation polyploidy regeneration of plants from cells or tissues in vitro and the transfer of genes from unrelated foreign source with the help of recombinant DNA techniques. Of late the techniques of tissue culture and that of recombinant DNA for the creation of novel

plant variants with respect to better resistance to biotic or abiotic stresses quality and quantity of crop harvest or for producing specific biocompound etc. have been termed as plant biotechnology. Plant biotechnology finds its base in the quest for improvement of plants in general or in relation to specific crop groups like spices vegetables cereals or trees and the techniques can be put to the improvement of any of them. Here attempt has been made to overview the biotechnological aspect of plant improvement in general with some specific available recent references related to crop species including spices and covered under two major subheadings. 1. The potentials of techniques related to tissue culture and 2. The potentials of techniques related to genetic engineering.

The Potentials of Techniques Related to Tissue Culture

Spices are heterogeneous group belonging to various primitive to advanced families and thus pose a challenge for their improvement by the use of biotechnology. The techniques of tissue culture could be speculated to be important for the improvement of these crops in three principal ways. The first is by looking for in vitro regenerated variants or somac1ones for yield attributing and other traits. The second is harvesting of specific biocompound or group of compounds prevalent in a particular spice crop in large scale cell cultures under laboratory conditions in bioreactors. The third is the standardization of regeneration protocols for commercial micropropagation of high yielding disease resistant or a heterotic hybrid cultivars as severals of spice crops are vegetatively propagated species.

Implementation of tissue culture techniques however is not so simple and encounters problems in regeneration protocols which are not universal and highly genotypic and species specific and not precisely reproducible. Hence accrual of beneficial genetic variability in vitro is a time labour and resource intensive process though commercial varieties have been produced in different crops by this method nonetheless the results have been limited and disappointing. Chances of creating beneficial variability are very high specially in case of crops having narrow genetic bases than those which have been well bred.

Thus the chances of success in such spice crops which are vegetatively propagated and have narrow genetic bases by dint of absence of natural breeding are quite high. The variability generated in tissue culture could however be exploited without understanding it genetically though variants must be evaluated over locations.

Of the wide range of variants generated in tissue culture most are generally deleterious or not novel to the parallel variants existing in the natural populations. In addition genetic instability is encountered with variant beneficial somac1ones which often revert back to normal after sometimes. The beneficial traits appear because of epigenetic changes which express for initial 2 to 3 generations and do no inherit afterwards. Based on which part of the plant is used to regenerate plants in vitro the basic culture technique is referred to be called as organ culture meristem culture anther ovule ovary and embryo culture protoplast culture protoplast fusion and culture or somatic cell hybridization. Similarly tissue culture derived variants have been referred as somaclones protoclones calliclones subclones and phenovariants. From the view point of creating de novo variability from tissue culture two main routes used for the regeneration of plantlets from explants or the callus formed from the explants are the somatic embryogenesis and the organogenesis.

Somatic Embryogenesis

Somatic embryogenesis is the process of production of embryo like structures (somatic embryos) from asexual or vegetative cells in tissue culture first observed in the cell suspension cultures of carrot (Daucus carota) followed by the observation that the phenomenon could be induced in the tissue culture of umbellifers and now known to be an event that could probably be induced in the tissue cultures of all plant families. Embryogenesis in cultures in usually induced by the removal of auxin or the substitution of less potent auxin like NAA for a more potent one e.g. the 2 4 D. Many cultures need a high auxin (usually 2 4 D) treatment prior to this triggering step in order to achieve the rapid rate of cell division leading to meristem

like conditions required for embryo initiation. In the later stages of embryogenesis sufficient amount of hormones are produced endogenously making them hormone autonomous. Highly variable sequence of cell division in plants creates problem in obtaining uniform experimental material during somatic embryogenesis providing ample chance of genetic variability or somaclonal variations on which selection can be made for improvement of desired trait or group of traits.

Production of somatic embryos from the cell tissue or embryo etc. cultures have been reported to proceed either directly (without an intervening callus phase) or indirectly after some form of callus cultures the former occurring generally from explants maintained on solid culture medium but the latter in case of limited number of species from liquid cell suspension cultures. Indirect embryogenesis is particularly attractive for micropropagation as long as genetic stability could be maintained. A vast number of somatic embryos could be produced in small volumes of culture media in a synchronous manner (e.g. 105 embryos from Ig of tissue) thus allowing mechanization and reduced labour costs for commercial production. Direct somatic embryogenesis has been of particular utility for haploid production from cultured anthers or immature pollens. Haploid plants have been reported to be regenerated in more than 50 species through anther culture with the majority in gramineae solanaceae and cruciferae and the one crop plant for which this technique works particularly well is the barley. The rapid production of inbred lines following chromosome doubling of haploids either spontaneously or using colchicine have been said to be exploited to produce varieties of rice wheat and tobacco. Such dihaploid lines have been found to be suitable for substituting near isogenic inbred lines (NILs) or recombinant inbred lines (RILs) used in DNA finger printing for identifying DNA markers for specific traits or quantitative trait loci (QTLs) traits governed by complex loci. The somatic embryos develop and germinate to form plants analogous to the germination of zygotic embryos. The somatic embryos could be and have been encapsulated with chemically synthesized covering of alginate complex and could be stored and transported to far off locations like the plant seeds tubers bulbs or rhizomes and have been termed as synthetic/artificial seeds. These could be grown into plants within stipulated periods by providing specific growth medium without exogenous hormones until plantlets reach a suitable size for further transfer to artificial soil vermiculite or the soil itself. This system could serve as cheap and alternative plant delivery system but several encountered problems still need to be solved. The main problem with the technique of artificial seed is not the embryogenesis but lack of plant regeneration from these embryos and poor viability after storage handling and transportation.

In addition to using somatic embryos axillary buds adventitious buds and shoot tips have also been used to encapsulate as artificial seeds. In plant species where somatic embryogenesis is not established these alternative explants could be useful for the production of synthetic seeds. Artificial seed production from various explants in alfalfa brinjal carrot brassica lettuce sandal wood rice horse radish mulberry eucalyptus vitis banana grape lettuce mango spruce orchard grass cardamom black pepper ginger turmeric vanilla cinnamon camphor anise lavender capsicum celery Carum carvi and coriander have been reported. Somatic embryo formation or plantlets regeneration from somatic embryos from several spices like ginger black pepper endangered spice Piper barberi garlic coriander caraway cumin fennel saffron celery black pepper have also been reported.

Organogenesis

It is the process of shoots and root formation one after the other in callus during tissue culture regeneration allowing to plantlet formation. Organogenesis has been reported to be more wide spread and controllable process than embryogenesis. In Convolulus the same meristem or primordium have been found to be induced to form a shoot or a root depending on the growth conditions of the culture hence Warren argued that perhaps shoot and root formation could be considered as facets of one basic process. In certain instances e.g. tobacco fairly precise hormonal switches altering growth conditions of the medium are

available that determine the developmental pathways followed in organogenesis. This makes these pathways useful systems for the study of control mechanisms involved in organogenesis.
The application of appropriate hormones is thus the main controls over organogenesis like the case with other types of differentiation during growth and development. Exact nature of hormonal triggers varies greatly between species however the ratio of auxin to cytokinin has been found to have consistent effect on a variety of systems. Work with tobacoo cultures have revealed that cultured issue responds to relative concentrations rather than absolute amounts of hormones. But however is not an universal phenomenon as it is not applicable in general to monocotyledonous species though it has been extended to many other species. Accepting these limitations it is established that high auxin concentration relative to cytokinins favours root formation and vice versa.. Precise amounts or concentrations in the medium will however be required to be standardized for mach species or genotypes under consideration. This behaviour could be used and have been used to induce plantlet formation by sequential initiation of shoots followed by roots.
Organogenesis from cultured cells depend on the presence of preexisting carried through from the explant or induced meristmatic primordia which are rapidly dividing groups of cells with a presumable capacity of spatial or temporal biochemical organization leading to differentiation. Usually presence of high auxin levels induced relatively vacuolated cultured cells to give rise to clusters of meristmatic cells under appropriate conditions. Preexisting meristmatic and vacuolated meristmatic cells (adventitious meristems) could be induced to proliferate by application of cytokinins which remove apical dominance effect while adventitious meristems could be induced from explant either directly or with the intervening callus stage. These pathways followed could have a dramatic effect on the genetic constitution of regenerated plantlets enabling the generation of somaclonal variation by the process of organogenesis on which selection can be made to effect plant improvement.
Most of the early plantlet generations through tissue culture is by following protocols responsible for organogenesis and termendous literature is available regarding this aspect in several crop species commercial or otherwise. Reports about the use of this method in spices have also started appearing in the recent literature. In a review Nirmal Babu have stated that tissue culture protocols for rapid clonal propagation and production of disease free plantings are available for over 35 major spices of which cardamom black pepper and vanilla are being produced commercially. In black pepper ginger and cardamom large number of somaclones has been produced to isolate useful genotypes with resistance to Phytophthora root rot soft rot and viral diseases respectively. In garlic tissue culture method with high propagation efficiency and in vitro bulblet formation has been developed by Ayabe which could be applied for generating virus free seed plants and Haque have developed a method of high frequency shoot regeneration and plantlet formation from root tips of garlic. Ahuja have shown the possibility of regenerating saffron plantlets through organogenesis from callus induced from bulblets. Formation of plantlets from adventitious shoots from sticky callus in ginger has been reported by Ishida and Adachi. Novel genetic variability generated through tissue culture either by organogenesis and/or embryogenesis is therefore expected to bring sea change in spice crops improvement in the near future.

Micropropagation

It is the process of regeneration of plants from a single genotype either by somatic embryogenesis or by organogenesis through enhanced precocious axillary shoot formation or production of direct adventitious shoots with minimum or no genetic variability for commercial propagation. At present for many horticultural crops there are protocols that allow in vitro regeneration in large scale of many plant species as a matter of routine. Multiplication potential of over 106 meristem tips/explant/year by direct adventitious bud formation in plantain/ banana and 105 somatic embryos from 1 g of tissue have been exhibited. This is actually the technique of cloning of plants in tissue culture which has now become the basis of a whole new world wide

micropropagation industry that multiply plants by this clonal method. Around 2000 different plant species have been observed to be amenable to be propagated by tissue culture on simple or large scale. In specific meristem culture is of general use in micropropagation. Commercial micropropagation especially successful with ornamental plants has now been extended to agricultural plantation crops such as potato strawberry oil palm and banana as well as to medicinal and aromatic plants and trees.

Micropropagation could be of specific use in the commercial production of spice crops like ginger and turmeric and other medicinal and aromatic plants which are generally propagated by vegetative means. Cardamom black pepper and vanilla are now being produced at commerical scale by in vitro techniques. Generally micropropagation from meristem culture has one advantage with respect to diseases caused by viruses. Viruses live within plants and are transmitted from one generation to the next specially in those crops that are vegetatively propagated. However for reasons that are still unclear meristem remains free from virus infection and micropropagation from it produces seedlings free of virus diseases and have been demonstrated in carnation strawberries cow pea chrysanthemum and peanut. Virus free plants have been reported to be produced from atleast 65 species and for example in potato alone atleast 130 cultivars have been freed from virus infection. Pathogen free plants have also been produced from stocks infected with mycoplasmas fungi and bacteria. Disease free meristem cultures are also an ideal source of material for micropropagation and have been found to show maximum genetic stability and least somaclonal variations than micropropagation from axillary or adventitious shoots as they show a loss of organized meristem in primary cultures. Murashige has described cell and organ culture methods in the establishment of pathogen free stocks while Quack have given an account of virus free clones regenerated from wide range of economically important crops. About 300 laboratories worldwide have been reported to be engaged in micropropagation by Murashige.

Secondary Metabolites from Cell Cultures

In fact the very importance of a spice as a crop is because of their synthesis of unusual chemicals/compounds called secondary metabolites in that part of harvest which is used as spice having medicinal or aromatic properties. Severals of such chemicals have been extracted from the crop plants grown in open fields. Culture technology others avenues of synthesizing such chemicals in laboratories rather than harvest from intact spice crops from the field. It renders biocompound production under environmentally controlled conditions free from diseases and pests flooding and droughts to which field crops are vulnerable and on a continuous basis without bothering for crop season and foreign political interference. In tissue cultures depending on biocompound product types plant species and the cell lines under consideration plant cell suspension cultures have been found to vary enormously in their capacity to produce and accumulate secondary metabolite products thus giving ample scope of electing cell lines with highest yielding capability. Culturing of such lines on large scale under controlled conditions provides opportunities of manufacturing such compounds from spices or any other medicinal or aromatic plants. Recent availability of gene manipulation technology has further raised exciting possibilities or the directed enhancement of secondary metabolite yields tremendously in the cell cultures in bioreactors. Optimization of culture conditions is one of the possible methods of raising production of target biocompounds in the culture medium. Screening and selection of higher yielding cell lines inherent in callus and suspension cultures from the existing natural variability in spice crops provides another possible method of raising production from the viewpoint of industrial success. Zenk while taking clue from this approach developed radioimmunoassays specific for determining variability in the synthesis of alkaloids ajmalicine and serpentine contents of a single root cell of Catharanthus roseus in cultures. Cell suspensions selected manually using this method were able to produce higher alkaloid levels than produced by the cells of whole plants in vivo. The fluorescent nature of alkaloid serpentine also provided an

additional means of screening by fluorescence activated cell sorting (FACS technique). In this under long wave UV light illumination serpentine auto fluoresces bright blue and could be visualized within the cell vacuoles using UV light microscopes.

Apart from above screening methods additional approaches of selecting high yielding cell lines could be tried for depending on specific instances of biocompounds and crop under consideration. For instance in C. roseus selection of high alkaloid producing cell lines could be possible by application of selection pressure in the form of addition of toxic amino acid analogues. In this plant indole alkaloids are derived from amino acid tryptophan via triptamine. When 5 methyl tryptophan analogue of tryptophan was added to cell cultures the enzymes for metabolism of tryptophan recognize this analogue as substrate in place of tryptophan and change metabolism culminating to the death of callus treated with this analogue. However if the few cells in a population of several millions have high internal capacity to synthesize tryptophan internally it competes with its analogue to allow the survival of such lines in the culture allowing identification of high tryptophan yielding cell lines and hence the lines producing indole alkaloids which is derived from the tryptophan.

Other than selecting high yielding cell lines for the production of biocompounds of interest in spice or medicinal plants another potential use of cell culture system is that of biotransformation. In this the conversion of one or more indigenously supplied precursor to more available product (s) is allowed in one or two steps reactions in the bioreactors. More complex multienzyme synthesis in which product is either synthesized de navo from basic culture medium components such as sucrose and salts or from a relatively distant precursor are also covered under the head biotransformation. Simple biotransformations are mostly stereospecific involving the addition or removal of single chemical groups by hydroxylation glycosylation acetylation and methylation such as the C12 hydroxylation of digitoxin to digoxin a heart drug by cultured cells of foxglove Digitalis lanata. More complex synthesis include the production of various alkaloids such as scopolamine in Hyoscyamus niger and in Atropa belendona anthocyanin in C. roseus and Daucus carota and anthraquinones in Morinda citrifolia etc. etc.

Irrespective of early optimism in the commercial use of these techniques large scale development of cultured cells for such synthesis remains a far cry due to problems that are encountered at biological and technological levels. One of the hilarious bottlenecks is the fact that in majority of cases studied so far cultured cells have been observed to synthesize and accumulate only very low levels of specific secondary metabolite under consideration usually levels lower than those present in the cells of intact plants.

As for the technological part is concerned large scale production of secondary metabolites in cultured cells per se or by biotransformation two main strategies have been tried so far. In the fermenter system approach freshly suspended cells are grown upto a stationary phase in one or two stage process and then harvested to extract the products. In immobilized cell system cells are embedded or entrapped in an inert polymetric matrix such as gels foam or cartridge of hollow fibers where the aim is to achieve a continuous or semi continuous production process which in turn requires that the product is naturally released or its release could be induced by reversibly permeabilizing the cells.

In large scale fermenter several species have been cultured successfully with often very low product yields. The only example of successful commercial production to cite so far is that of red pigment shikonin in fermenter developed by Mitsu Corporation of Japan. Immobilization which is relatively new for plants is yet to deliver results of commercial significance but it has potential advantages of both the physiological and chemical engineering nature. A general account of bioreactors for the production of various compounds per se or through biotransformation by plant cell immobilization technique along with the major problems encountered and that remains to be solved for determination and maintenance of optimal conditions for product formation in bioreactors and for understanding what factors are crucial for scale up have been detailed by Scragg. The use of shoot root and embryos as explants to generate callus or suspension cultures for enhancing product yields in some specific cases have been discussed by Stafford.

Some of the most promising secondary metabolites which have shown the possibility of their production by mass cultivation of cells are taxol camptothecine anti cancerous) artmisin (anti malarial) ginkgolides (anti allergic) and berberine osemerinic acid shikonin atropine and scopolamine. Production of vanillin from Vanilla plantifolia and C. oseus volatiles from Mentha species lavender Ocimum anise celery saffron etc. organosulpher compounds a garlic and catharanthine from C. roseus have been reported. It is hoped that methods to give scale up production in some of these species for the concerned specific biocompounds be developed sooner or after for large scale production in bioreactors.

Spice Processing

Although this chapter is not designed to be a complete primer on the subject of the cleaning and grinding of spices. It is very helpful to understand the principles involved when preparing spice specifications. An understanding of what can and cannot be done by a spice processor will reduce misunderstandings when developing spice specifications.

In the United States spices can enter the food supply as raw uncleaned spice raw cleaned spice ground uncleaned spice or ground cleaned spice. Spices can also be postprocessed to reduce microbial counts. All too often spice buyers look only at pricing issues and forget that these spices are used as food items. There is a large market for spices that have not seen any cleaning procedures other than that obtained during harvesting. A spice processor that has adequate spice cleaning facilities can quite easily show a collection of trash that has been pulled out of lots of cleaned spices. Besides the common stones rodent droppings and insects the authors have seen nail baling wire nuts and bolts cigarette packages dead rodents fist sized rocks charcoal wood and numerous other items pulled out of spice lots that theoretically comply with FDA regulations. It is still too easy for a spice supplier to just transfer a spice from the original bale or bag to his box and claim that the spice has been cleaned. Finding the one large stone or piece of glass is an impossibility for the user s quality control departments. It is much better to know that the processor has the appropriate cleaning and grinding equipment and knows how to use them.

Spice Cleaning

All spice cleaning equipment takes advantage of a physical difference between the spice and the foreign material being removed. Most often these physical differences revolve around shape and density. The closer in shape and density the foreign material is to the spice in question the more difficult it is to remove. Before moving on to the types of equipment that are used it must be stated that these cleaning operations do cost money. There is the cost of the cleaning equipment the labor and most importantly the loss of product that inherently comes with the cleaning operation. It is nearly impossible to perform a cleaning operation at reasonable production rates that results in a pile of foreign material completely free of spice and a pile of spice completely free of foreign material. To be sure that most of the foreign material is being removed some spice must also be removed. The opposite of this is also true at reasonable production rates it is impossible to guarantee the absence of any foreign material in a lot of cleaned spice. A specification needs to be written for how much foreign matter is allowed in the cleaned spice. This specification has to be checked from time to time to ensure that the equipment is working properly. Here some very simple checks can work well. One simple check is to drop about a pound of black pepper into a beaker and use a stream of water to flush the pepper berries out leaving any rocks or heavier foreign material in the bottom of the beaker. If anything is found the system needs some adjustment. Some sort of laboratory examination of the product is needed to really determine if the cleaning equipment is working correctly.

Magnets

Every spice cleaning system should include magnets in as many locations as possible. Magnets should not be thought of as protection only for the end users but also for the processor since magnetic material needs

to be removed so it won t damage the milling equipment. Although there are a wide variety of magnet styles there is no one magnet that is perfect for all systems. The placement and maintenance of the magnets is also important. No magnet will pull a small piece of metal through a solid flowing stream of dense spice. To be effective the magnetic surface must come in very close proximity to the metal and be designed such that the flow of spice over the magnet cannot brush the metal piece back off the magnet and into the product. In addition the magnet must be cleaned frequently since even well designed magnets can only hold so much metal before the flow of spices will knock the metal back into the product.

Typical magnets come in bar and plate forms. To be effective the spice should flow in a loose stream over the magnet. Systems that bounce the spice particles over more than one magnet are the most effective. Cleaning of the magnets is very important. An effective cleaning procedure will include documentation of cleaning frequency as well as records showing the type and amount of material collected.

Sifters

The most basic cleaning operation is the utilization of sifters. By running the spice over a set of screens one can remove particles both larger and smaller than the spice that is being cleaned. Although the principle sounds easy enough it is generally very difficult in operation. Remembering that spices are often not uniform round spheres but uneven oval seeds or random pieces of leaves the problem becomes much more difficult. Sifters are generally not often used for cleaning but for sizing.

If the farmer doing the harvesting does any cleaning at all it is generally not much more than a simple sifting operation to remove large debris.

Air Tables

Probably the most versatile piece of cleaning equipment for spices is the air table or gravity separator. This piece of equipment is usually the one piece that a processor obtains first and uses most often. At first look an air table seems to defy nature. The heavy material comes off the high end of the table and the light material comes off the low end of the table. A look at the following diagrams will show how this is accomplished. In Figure 1 there is a wire mesh screen with a stream of air blowing up through it suspending the spice particles just over the top of the screen. Naturally the lighter pieces are suspended higher than the heavier pieces. The lighter pieces are represented by L s and the heavier pieces are represented by H s. The very lightest pieces are actually blown out of the system by the air stream. In Figure 2. the screen is tilted and all the spice particles have moved to the bottom end of the screen. In Figure 3 a rotational vibration has been imparted to the screen. This rotational vibration is adjusted so as to just touch the heavier particles and tap them. The screen is built such that these taps tend to push the heavier particles up the screen where another rotation of the screen taps the heavier particles again and again. This repetitive tapping walks these heavier particles up the screen as shown in Figure 4. Since the screen does not tap the lighter particles they continue to migrate towards the lower end and cause a separation. In practice the tilt of the screen the rotational vibration of the screen and the airflow through the screen are adjusted so that the cleaned spice migrates to the middle of the screen the heavy filth migrates to the top of the screen and the light filth migrates to the bottom of the screen. Often the very center is collected as clean spice the very top discarded as heavies and the very bottom discarded as lights while the area between the heavies and the cleaned spice are recycled for another pass. The area between the lights and cleaned spice are also generally recycled through the system again. This recycling allows a relatively narrow range of cleaned spice to be pulled from the center and sends the marginal material back to be recleaned.

Although the air table is a very versatile piece of equipment it does have its limitations. An air table can separate particles of the same size and of different densities. It can separate particles of the same density and different sizes. But it may or may not be able to separate particles of different sizes and different

densities if the airstream floats a large surface area particle of relatively heavier weight at the same height as a small surface area particle of lighter weight. Since the air table separation is accomplished by how far the airstream suspends the particles above the screen it is understandable how particles of varying sizes and weights might be suspended at the same height over the screen.

Destoners

Destoners work on the same principle as the air tables but are generally much smaller in size. Where an air table is able to separate the product stream into as many divisions as is desired a destoner is generally set up to remove only the heavier stones and rock. Destoners usually have a much smaller screen surface than an air table and are set up to only remove the heaviest pieces. Once again by varying the air flow the incline of the screen the vibration of the screen and the type of screen it is possible to make the stones walk up the screen and thus affect a separation from the lighter material. Destoners are often used by themselves or with the heavies off the airtable to reclaim more good product from the heavies stream.

Air Separators

Although air separators can be designed in many ways the basic principle is the same in all. The principle can be represented by a narrow stream of spice falling through a horizontal air stream. In general the heavier particles will fall straight down through the air stream while the lighter particles are blown to the side causing a separation. Air separators are built in a number of styles sometimes using a vertical flow of air but the principle is the same.

Indent Separators

The indent separator tries to make use of the difference in shape between the spice and the foreign material. The spice is fed into one end of a revolving drum. The outside of this drum is lined with uniformly shaped cavities that the particles can fit into. The cavities are sized so that the desired shape of the spice particle will fit well. The centrifugal force from the rotating drum will hold the right shaped particles in the cavities longer than it will hold particles that will not fit well in the cavities. The rotational force lifts the correctly shaped particles and when they do eventually fallout of the cavities they are collected in a trough and moved out of the machine. The particles of the wrong shape eventually fallout the far side of the revolving drum.

By varying the shape of the cavities (indents) and the rotation of the drum very effective separations can be made based on size or shape. Indent separators are quite effective in removing stems from herbs and oblong seeds.

Spiral Separators

Spiral separators work well separating round seeds from nonround foreign material. A spiral separator is a U shaped trough that is curved into a downward spiral much like a child s curved slide at a park. By feeding spices into the top of the separator the round particles gain speed as they roll down the chute. As the round particles pick up speed centrifugal force drives the round particles up the side of the chute. The non round particles do not roll and cannot gain the same momentum and end up sliding down the center of the chute. A splitter at the bottom of the chute separates the round particles that have climbed the side of the chute from the non round particles that slide down the center of the chute. The principle is much the same as cars coming off a banked turn on a racecourse. The faster cars move to the top of the bank while the slower cars can take a course closer to the bottom.

Spiral separators are amazingly simple devices since there is no need for motors or blowers. Gravity drives the entire operation.

Spice Reconditioning

Spice reconditioning was discussed earlier as a method to remove contaminants and bring spices into conformance with both Federal law and ASTA Cleanliness Specifications. Reconditioning involves nothing more than cleaning steps outlined above. The FDA wants to know how the spice is planned to be reconditioned prior to performing the work. They may want to supervise the operation to ensure adequate removal of the contaminant. Under ASTA procedures supervision is not necessary but the lot must be resampled and tested by the independent laboratory. If the lot is passed by the laboratory ASTA s tracking program will tell if the lot was in fact reconditioned a fact that the buyer may well want to know.

If faced with an imported lot that needs to be reconditioned or just recleaned there are companies that specialize in these operations and have a good understanding of FDA requirements. They will be able to offer excellent advice as to how to proceed.

The importer of the goods is usually responsible for the entire cost of reconditioning. In many cases it is difficult to get the overseas shipper to pay these costs.

For someone wishing to import their own spices and save a few pennies it is worthwhile remembering the types of problems that may arise.

Spice Grinding

The basics of spice grinding are very simple. There are a variety of mills used to grind spices and they are generally designed to cut crush or shatter the spice particles.

First of all the process of grinding ruptures a number of the glands in the spice that contain the volatile oil and frees this oil for reaction or evaporation. It is this rupturing of the oil glands that presents the biggest problem in grinding. Along with the volatile oil being more exposed grinding also generates some heat which will tend to vaporize this oil leading to a reduction in flavor strength. Any spice that you can smell during grinding is experiencing some degree of flavor loss. While no grinding system can ensure no flavor loss it is in the grinder s best interest to keep the temperatures as low as possible to minimize the loss of volatile oil.

Most spice mills are designed to pass the spice through very quickly and minimize the heat buildup. The choice of mill that the processor will use for a particular spice is often determined by the temperature rise during processing. Various mills can be configured in various manners by changing internal screens speed and internal clearances to control the heat buildup. Grinding the spice to a finer particle size will increase the temperature. Producing a larger particle will generally result in a lower temperature. This choice of mills and processing procedures is what controls the throughput of the spice. It is in the processor s best interest to grind the spice at as high a rate as possible while trying to maintain an adequate quality.

A few processors utilize liquid nitrogen to keep the temperature very low and minimize oil losses. Although cryogenic grinding is not wide spread there is value in its use. By freezing the spice and solidifying the volatile and fixed oils these spices grind and sift a lot easier. Since the spice is frozen it shatters when subjected to a milling operation. By maintaining very cold temperatures cryogenic grinding can retain more of the flavor components which are normally lost during regular ambient grinding. Cryogenic spices contain more volatile components as well as more of the lower molecular weight volatile components resulting in more flavor and a different balance of flavor more true to the natural unground spice. In addition other differences include higher moisture content in ground spices since there is no heat involved to evaporate some of the moisture. Cryogenic grinding will also minimize oxidative deterioration of the flavors due to the nitrogen blanket during grinding. For the food technologist cryogenic spices can have advantages. First of all a spice ground cryogenically may have a different flavor profile. The top notes may be an advantage in the right product giving a fuller flavored product. Since the product has more flavor less spice can be used to achieve the same flavor level.

Milling operations often include a sifting operation. The mills may have internal screens that in part dictate

the final particle size or the sifting operation may be a separate operation where the oversized particles are returned to the mill for further processing. In either case the setup of the mill or sifters determines the particle size of the finished spice.

It is important to look at the particle size control of the ground spice since nearly all spice specifications contain a granulation parameter. Many granulation specifications have been developed without regard to the processes used to produce ground spices. All too often it appears that a granulation specification is developed by taking a sample of the ground spice and running it through a set of laboratory screens to develop a particle size survey (x amount on a ISI. Standard 30 mesh screen y amount on ISI. Standard 40 mesh screen etc.). With this survey in hand the food technologist develops a range around each screen used that theoretically ensures every lot of spice will look similar as far as granulation is concerned. The fallacy here is that not all lots of spice produced on the same mill will have the same distribution of particle sizes. And certainly different mills used by different processors are going to give different distributions. If the intent is to develop a specification that only one spice processor can meet this type of granulation specification is going to do it. It is in the user companies best interest to develop specifications as broad as possible in order to allow as much competition for suppliers and therefore reduce the user s cost. For those cases where a very strict granulation specification is necessary for some reason possibly for spices that can be visually seen in the finished product then it is certainly correct to be very specific.

As an aid in writing reasonable granulation specifications it is worthwhile to review how spice processors control the particle size of their spices. Most spice mills will produce a wide variety of particle sizes for any given setup of equipment and choice of spice. For the most part a distribution of particle sizes is not unlike a normal distribution as represented by a bell shaped curve. There will be some quite large particles as well as some very small particles. For the most part this bell curve is quite broad and it is very difficult to tighten this curve to any significant degree. A sifting operation changes the shape of the distribution significantly by cutting off very abruptly the coarse or fine end of the range. By developing a granulation specification by the survey method described earlier the exact shape of this bell curve may inadvertently be described thus making it very difficult for any spice processor to produce the exact same product on a continuous basis.

One needs to take a close look at the parameters of importance that need to be controlled when developing a granulation specification. In most cases the spice particles should be small enough that they are not visually obvious or felt by the mouth when consumed. Large pieces of ground allspice in a wiener would be undesirable because they would stand out visually and they would feel like sand in the mouth when consumed. Here particles smaller than a Indian Standard (U.S.S.) 30 mesh are probably sufficient. Specifying particles that are significantly finer may be detrimental since it takes more grinding and correspondingly higher temperatures and volatile oil losses. Specifying how much of the allspice must pass a U .S.S.40 50 or 60 mesh screen is of no importance if it can t be seen or detected in the finished product anyway. It is worthwhile to discuss with the spice processor what are their standard granulation specifications so something that is even just a little finer than a standard product is not specified. It is interesting to note that cinnamon is generally ground fairly fine a BIS. 60 or 80 mesh because it feels very gritty on the tongue at coarser sizes. This is one spice where cryogenic grinding does offer advantages since the product usually is ground very finely the liquid nitrogen keeps it cold and prevents excessive oil loss.

Granulations are usually described using screen sizes. Most laboratories have access to a set of laboratory screens that are numbered by BIS Screen sizes. In general the size of the screen can be thought of as the number of openings in the screen per inch. In general a BIS #4 mesh screen has 4 openings to the inch. A BIS #8 mesh screen has 8 openings to the inch. Thus the larger the number the smaller the particle.

To complicate the matter further there are a number of systems of numbering screen sizes and a BIS #8 mesh is not necessarily the same size as a Tyler #8. A comparison of these screen systems is shown in

Table 1. Descriptions of a 28 mesh 30 mesh and 32 mesh black pepper may all have the same particle size depending what screen numbering system is being used. Therefore when discussing granulation specifications it is very important to specify the screen numbering system. It appears that most industry specifications are written based on U.S.S. screen sizes.

There are special cases where the particle size must be controlled to a relatively narrow range. The common industry practice here is to use a / + designation. Thus a -30+80 mesh black pepper (often referred to as dustless since the fines have been removed) is one that passes a 30 mesh screen and is retained on an 80 mesh screen. In general a spice with this particle range is produced by sifting off the coarser and the finer particles. Although spices sifted in this way have a quite uniform distinct particle size. it must be remembered that the fine product being produced is probably a by product that the processor has to sell at a lower price. An example of the black pepper demonstrates the case quite well. Using a 30 mesh black pepper (everything passing a 30 mesh screen without the fines being removed) as the starting point a -30+80 black pepper will be discussed. A second processing step is added to remove the fines or the 80 mesh material. The extra processing dictates a higher cost. In addition there is not a strong demand for the 80 mesh fines so it usually sells at a lower price. This lower price for the fines separated out of the 30 mesh material boosts the price of the -30+ 80 black pepper to a greater degree.

As can be seen in Table 1 actual production screens are not identical in size to BIS laboratory screens. To prevent problems translating from one measurement system to the other specifications are often written giving some tolerances. For example a product ground as a BIS 30 mesh product is often specified as 100% to pass a BIS #25 and a minimum of 95% to pass a BIS #30 screen. This builds in the tolerances for screen variation as well as some wear and tear in production screens. Using the 100% through a BIS #25 screen specification also ensures that no very large particles are present in the finished product which could be present if there is a problem with the mill screens during grinding.

Quality Issues with Spices

This chapter will deal with the quality issues of spices. The parameters of concern generally revolve around cleanliness safety or economic elements. The cleanliness elements are set forth in Federal law such as FDA DALs or in trade practices such as the ASTA Cleanliness Specifications. These were discussed in Chapter 1. Safety issues include microbiology and moisture levels. The economic issues have to do with the flavor level and granulation.

The spice industry has worked together to develop a set of standard methods of analysis that help define how these parameters are measured. The current set of industry adopted methods is available from the Indian Spice Trade Association

The most important point to remember when working with these methods is that they are strictly empirical methods. This means that the trade defines moisture as the result of the specified testing procedure not necessarily a strict measure of how much water is present in the product. The test methods as accepted by the industry need to be followed strictly to ensure that results are comparable from lab to lab. A modification to a test method that gives volatile oil readings higher or lower than the standard method are worthless since the term volatile oil as used by the industry is defined by the results of the established test.

This is not to say that a company cannot use a different testing method if it has some unique value for that company but when talking to members of the trade it is extremely important that one defines the test method being used. Comparing a Karl Fisher moisture test method result against the ASTA moisture method will give different results. Only if the test method is described is the result understandable. For the most part it is easiest and most accepted to use the methods as adopted by ASTA for establishing specifications.

The ASTA test methods are continually being refined to make the methods produce the most reliable and

reproducible results.

Sampling

The biggest problem faced in the analysis of spices is collecting a sample representative of the lot as a whole. As discussed in Chapter 1 many lots of spices are a consolidation of small parcels from many small growers or harvesters. This means that a single large lot may face large variation in composition within the lot. Generally the spice cleaning and grinding steps will eliminate some of this variation but it with not removes all of it unless the product is blended. This variation is probably the cause of most of the problems between suppliers and users. Most spice processors will sample a given lot of spice many times while it is being processed and run a composite sample. This composite sample is a far better estimate of the overall lot quality than a single grab sample. As much time and effort needs to be put into the taking of the samples as put into the actual analytical work.

When testing a given lot for cleanliness the ASTA Cleanliness Specifications require pulling samples from individual bags representing the square root of the total number of bags in the lot up to a maximum of 10 samples per lot. This is a good rule of thumb to follow when sampling any given lot of spice for any parameter. If these 10 samples are composited the end result says nothing about the variation within lots but does give a good idea of the overall lot average.

Some ASTA members are suggesting that the trade look at a three class sampling program that would give a better idea of the composition of a given lot with less samples but more testing. Essentially this sampling program requires five individual samples from the lot to be analyzed for the parameter of concern. Based on the five individual results statistics can be used to estimate the actual composition of the lot. This modification of the standard sampling plan has been slow to catch on but some industry users have adopted similar plans especially for microbiological examinations.

Sample Preparation

Nearly as important as sampling the sample preparation is an important part of the testing procedure. Industry practice has established that all spice analysis should be conducted on spices that have been ground to pass a BIS. #20 mesh screen. Spices which are tested that are finer than this need no further preparation but those spices purchased whole or coarsely ground will need further particle size reduction. It is important that this grinding takes place rapidly without any significant heat buildup. Laboratory mills that have a large mass of metal compared to the mass of spice being ground will help keep the temperatures of grinding down. Maintaining the mills in good working order with sharp knives and cutting surfaces is a must. Remember that the entire sample must be ground to pass a BIS. #20 mesh screen Material retained on a BIS. #20 mesh screen must be passed through the grinder again. While grinding some spices finer will give differing results it is important to try to follow the standard method if one is looking for standardized results. The storage of the sample is extremely important. Spice samples stored in polyethylene bags can lose an appreciable amount of volatile oil overnight. It is important that ground spice samples be stored in glass containers and preferably refrigerated.

Volatile Oil

The most commonly run test on spices is the volatile oil. The laboratory method consists of boiling the spice in water and collecting the condensed water and volatile oil. The amount of volatile oil is measured by volume and the results reported as milliliter per 100 grams of spice. There are adaptations designed for certain spices. For example the volatile oil of cassia has very nearly the same density as water and it is difficult to hold the oil in the trap. By adding a measured amount of xylene to the trap it is easy to hold the oil. When the amount of oil is measured the amount of xylene added is backed out of the calculation. For this method it is very important to follow the test method word for word.

The volatile oil measurement is a fairly reliable indicator of flavor content for those spices where the principle flavoring components are in the oils. For example. red peppers have no volatile oil and the bite or heat comes from chemicals that are extracted into an oleoresin. Therefore volatile oil is not done on red peppers.

The measurement of volatile oils in spices is also a good measure of the age and processing conditions the spice has seen. Ground spices will slowly lose their flavor and volatile oil after prolonged periods of storage. Spices that have seen high temperatures during grinding will also show losses of volatile oil.

Moisture

The measurement of moisture in spices presents some unusual problems. Moisture is usually measured in food products by measuring the weight loss of a sample stored under warm temperatures. The volatile oils typically found in spices are also lost during drying and this weight loss would also be measured as moisture. To resolve this problem the trade has adopted a co distillation method for most spices. In this test the spice is covered with toluene and the toluene brought to its boiling temperature. The moisture in the spice co distills with the toluene and as the toluene is condensed the moisture separates from the toluene and is measured.

All spices cannot be tested for moisture in the same way. Paprikas and other capsicum products tend to caramelize during the distillation with toluene and additional water is produced from this reaction. Thus paprikas and capsicums are analyzed with the more traditional oven method.

Although it would seem that a Karl Fisher titration could be employed for spices the cost and technical knowledge required has been a drawback to common acceptance. In addition the small sample size usually used for Karl Fisher titrations may lead to erratic results.

The moisture level of spices is of practical importance as a control of microbiological growth. Although the measurement of water activity would be a much better indicator of potential for microbiological growth the industry has established traditional moisture limits which have had the same effect. These limits for each spice are listed in Chapter 4. Moisture migration in large containers can be a significant problem if stored in a warehouse with varying temperatures. For example chili pepper exposed to falling temperatures can have moisture condense on the top of the bag which could fall on top of the product and cause mold growth.

The moisture level of spices also affects the grinding characteristics of some spices. In particular it is very difficult to produce a cracked bay leaf when the moisture level of the bay is very low. At low moistures the leaves are very brittle and a large amount of fines are produced upon cracking. At higher moisture levels the leaves are quite pliable and the excessive fines are not generated. When trying to grind bay into a fine mesh the dryer leaves work better.

Extremely low moisture levels can also cause shelf life problems. Very dry spices tend to lose flavor quicker than higher moisture spices after grinding. In paprika it is very important to keep moisture levels reasonably high (9% 12%) to help retain extractable color. Color losses in very dry paprika can be excessive.

Total Ash and Acid Insoluble Ash

The total ash and acid insoluble ash content of spices is a measure of the amount of sand and grit in the spice. The total ash determination is performed by heating the sample until all the organic matter has been burned off. The acid insoluble ash is the material remaining after the total ash has been treated with hydrochloric acid. The acid insoluble ash is a fairly reliable indicator of the sand or grit content. It is important to remember that a perfectly clean spice does contain some inorganic minerals that are measured as acid insoluble ash. The levels shown in later chapter are levels that can be attained by careful cleaning prior to grinding.

The total ash content is also a clue that some spices may have been limed. In this procedure spices like ginger are treated with lime during the drying procedure to bleach the product. This added lime can show

up as a higher total ash.
Paprikas and capsicum products are often treated with an anticaking agent such as silicon dioxide to help retain a free flowing product. These products will have a higher total ash and acid insoluble ash than products which are not treated.

Granulation

The particle size of spices is determined by sieving the material through a set of standard laboratory screens. Since many spices are quite oily they tend to easily blind the screens and inhibit an accurate measurement of particle size distribution. To facilitate the laboratory screening process the spice sample is treated with silicon dioxide. The test method dictates the sample size the method of shaking and the time of shaking. All of these parameters are important to ensure reproducible results. It is also important to ensure that the screens are clean and oil free. Regular rinsing of the screens with acetone is helpful.

Crude Fiber Starch and Nonvolatile Methylene Chloride Extract

The tests for crude fiber starch and nonvolatile methylene chloride extract are tools to detect adulteration of spices. Although not a common practice these days these tests are useful for the detection of the addition of other nonspice organic matter. These tests are not regularly used.
The crude fiber test is essentially the same for determining crude fiber in other food products. High crude fiber results may occur if sawdust or other fibrous materials are added to a spice such as ginger.
The starch content of some spices can be a clue of adulteration with starchy materials such as flour. Some old dry spices can take on a new appearance if vegetable oils are added. The nonvolatile methylene chloride (ether was the original solvent used for this test but has been abandoned due to flammability hazards) extract can help detect this addition.

Spice Specific Tests

There are a number of tests developed to measure the quality of individual spices. These tests measure an important property of a particular spice.

Meat Seasonings

Overview of the Industry

This chapter will deal with meat seasonings. It is not meant to inform how to formulate sausage or other meat items but merely tries to give information necessary to formulate seasonings for the meat industry. Levels of restricted ingredients BIS labeling regulations as they apply to seasoning blends and a few sample formulas are included. The technical aspects of formulating meat items are best left to the technical experts in the meat industry.
Meat seasonings are usually low margin items. Often companies will switch suppliers for a few cents difference in cost per pound. If formulating sausage seasonings it is essential to have an economical source of ground mustard seeds. Often sausage seasonings contain a high level of mustard and unless grinding your own it is hard to be competitive.
Certain seasoning companies are known in the industry to be primarily meat seasoning suppliers. This is usually due to two main reasons the first being that many of the smaller seasoning firms were initially formed by large meat companies to provide seasonings to their processing plants and then were either expanded to sell seasonings outside the company allowed to operate independently or were sold. The second reason is that some seasoning houses were initially involved in meat seasonings due to their technical expertise. Many small meat companies have relied in the past on technical support from the seasoning company to formulate their meat items and teach them how to produce the product. Some of these seasoning companies provided the seasoning the smoke flavors the sausage casings miscellaneous

ingredients and the technical support to produce processed meat items like summer sausage and wieners. Even fairly large companies in the past utilized the seasoning company as a technical reference much more than they do today. Now most processed meat manufacturers have their own laboratory and research personnel.

Items that seasoning companies usually provide seasonings for in the red meat industry are fresh cured smoked and dried sausages nonspecific items such as meat loaves and luncheon loaves ham brines corned beef pickles roast beef rubs and products like chili and taco meat. Seasonings for poultry items include pumps and basting blends sausage seasonings such as turkey bologna ham and breakfast sausage and marinades and glazes.

There are hundreds or even thousands of possible flavor combinations for each type of product. The flavor of the product itself varies by region in India. For example chorizo bought in different geographic areas will be vastly different. It can be dry semidry fresh cooked cured hot or mild fine or coarse grind or red to pale orange. In addition there are an infinite number of variations of flavor available.

Overview of Formulating

To formulate seasonings for the meat industry it is essential to have a basic knowledge of BIS labeling regulations including the flavoring regulations which became effective in March 1991 the level of restricted ingredients in various products and a basic knowledge of how meat items are produced. Ideally a first time formulator should have the opportunity to apprentice with someone more knowledgeable in this area. In addition the opportunity to duplicate meat seasonings gives the formulator a background as to which flavors are present in which products. Chapter 12 will detail the duplication of seasoning blends more fully. This chapter will attempt to provide some basic information to start formulating meat seasonings.

Meat Block

This is the amount of meat used in a formula. Seasonings and other ingredients are added on the basis of the meat block typically in 100 pound increments. For example the directions on a seasoning label would read Use 6.5 pounds seasoning per 100 pound meat block. A meat processor makes his items in these 100 lb increments either 500 pounds 1000 pounds or 700 pounds whatever his equipment will allow. Any other ingredients including water are added based on the 100 lb of meat. Many times manufacturers provide the seasonings in batch size bags for whatever amount of product the meat processor is making. In the example above if it is a 500 lb meat block then the seasoning would be packed in a 32.5 lb bag. Restricted ingredients are usually based on the amount per 100 lb meat block.

Cure

A cure is the product used to treat meat for a longer shelf life and give it a characteristic pink color and cured flavor. Bacon ham corned beef bologna and wieners are all cured Curing meat products increases shelf life and stops the growth of Clostridium botulinum which would be able to grow and form its deadly toxin in vacuum packed meat items. Cures contain salt sodium nitrite and less commonly sodium nitrate (limited to some extent since the nitrate is associated with increased formation of nitrosamines during cooking which have been found to be carcinogenic) and an anticaking agent. Sugar is also sometimes present. Some cures are colored with FD&C Red Dye #3 giving the product a pink color. This is done so meat manufacturers will not confuse the cure with salt in their plant. Sodium nitrite is restricted in sausage items to 156 ppm. Most cures contain 6.25% sodium nitrite and the usage level is 0.25 lb (4 oz) to 100 lb meat block. Other cures can contain 12.5% sodium nitrite. Other levels of nitrite cures for specific products are available however the two types described above are the most common. Cures are never included with the seasoning because many seasoning components such as hydrolyzed vegetable proteins contain amines and thus may combine with nitrites and nitrates to form nitrosamines which are carcinogens (21

CFR 170.60). See Chapter 6 for a more complete discussion.
Cures are either sold separately in drums or packed in batch size amounts. In the 500 lb meat block example 1.25 lb of cure would be packed in its own separate bag and placed inside or attached to the outside of the seasoning bag (cure twinpack or piggyback). The operator would then only have to add one bag of each product to his meat formula with no extra weighing of his seasoning ingredients. Some meat processors purchase all their seasonings in these batch size increments others buy the seasonings in bulk. Since sodium nitrite levels are regulated seasoning manufacturers must analyze each lot of cure to confirm that it contains the proper amount of nitrite.

Curing Accelerator

The curing accelerator most often used in the meat industry is sodium erythorbate. A second less used product is sodium ascorbate. Sodium erythorbate is the mirror image isomer of ascorbic acid (Vitamin C) although it has no vitamin activity. Cure accelerators help increase the pink color of a cured product and must be used in combination with a curing agent. They are limited to 550 ppm (7/8 of an ounce to 100 lb of meat). Sodium erythorbate is commonly added to the seasoning blend.

Brine

A brine is a water soluble solution of seasonings salt sugar sodium erythorbate phosphates and cure which is pumped or injected into a meat item such as ham or corned beef. All flavoring materials should be water soluble although small amounts of garlic powder are possible due to its small particle size. Often oleoresins are used in this application with polysorbate 80 or other emulsifier present. The brine is formulated so that if the product is pumped 20% the level of restricted ingredients is at the proper amounts. Pumping 20% means that if 100 lb of meat is pumped with this solution then 120 lb of finished product results. See Table 1 for an example of a pump calculation.

Pickup

This term is utilized primarily in the poultry industry. If a 15% pickup is desired then the poultry is marinated vacuum tumbled or injected so that 100 lb of chicken weighs 115 lb. This is important to know when formulating seasoning for the above types of items so the strength of the flavor salt and phosphate is kept at the proper level. Injected seasonings must be water soluble. Vacuum tumbled or marinated products can use some nonsoluble particulate ingredients.

Formulations

When formulating for meats it is much more practical to formulate based on the weight of an ingredient needed for a stated amount of meat block rather than working in percentages. To produce a product such as a wiener seasoning it is important to work in weight of seasoning per 100 pounds of meat. When the formula is designed this way it can be converted to percentages and the seasoning formula can be produced. If the formulator wants to reduce one item such as dextrose he can convert back to weight per 100 pounds reduce the weight of the item and calculate back to percentages. The usage per 100 pounds will decrease and the percentages of ingredients will change but the weight of the ingredients added per 100 pounds of meat will stay the same. See Table 2 for an example.
The 3.806 lb and the 3.556 lb are the amounts of seasoning added to a 100 lb meat block. The formula change reflects a 0.25 lb (4 oz) reduction in dextrose and thus a 0.25 lb reduction in usage per 100 lb of meat. This causes the formula percentages to increase but not the amount of other ingredients which are added to the meat. To double check this take 1.52/100 (percent of S/E in second formula) x 3.556 lb (seasoning usage) = 0.054 lb. This is the amount of sodium erythorbate added to 100 lb of meat in either formula. Calculating formulas in this way allows tighter control on the level of restricted ingredients. It also ensures that the other ingredients will stay the same while manipulating the formula.

These types of calculations based on usages are used most often in the meat industry. They can also be helpful when formulating products such as sauces and gravies. If blends are formulated in usages increasing or decreasing various flavor ingredients while keeping salt and starch levels the same per cup or gallon of gravy mix is very simple.

The result of this new legislation is that most ingredients must now be broken down to their component ingredients which the FSIS decides upon. For example a flavor blend to replace MSG may have been labeled as natural flavor in the past. It now has to be labeled with all its components which may be maltodextrin salt autolyzed yeast extract hydrolyzed vegetable protein citric acid and natural flavor. This regulation has complicated labeling tremendously.

Reaction flavors are another problem. Generally reaction flavors are produced by the treatment of amino acids or other proteins along with sugar under heat to produce meat flavors.

Snack Seasonings

Overview of the Industry

Savory snacks are a huge industry Sales in 1991 were Rs. 13.4 billion or 4.92 billion rupees. This chapter will discuss a variety of salty snack seasonings. The products included in this chapter are potato chips tortilla and corn chips extruded snacks popcorn nuts and rice cakes. A breakdown of the volume of these snacks can be found in Table 1.

Flavored chips are a value added item. The seasoning can make or break a product and sufficient sensory and market testing is necessary to produce an acceptable flavor. The seasoning also adds quite a bit of cost to the product. A seasoning of $1.50 a pound will add $0.18 to an 8 oz bag of potato chips. These figures are based on an application rate of 8%. This is a high figure compared to other products where the seasoning usage rate is often in the range of 1% 2%. Often the retail price of the flavored chip is not any higher than the plain chip thus it is essential to get the most flavor for the money. It is important however to purchase a seasoning that tastes good rather than on price alone since it is so important to the sensory attributes of the final product.

Potato chips sold in India in 1991 were 1.57 billion kgs. Unflavored chips are still the biggest seller having 69.7% of the market. BBQ is by far the most popular flavored chip holding 12.7% of the market. Sour Cream & Onion is the next favorite with 8.8% of the market. Cheese flavored chips are 3.5%. Other flavors including Cajun Salt & Vinegar Hot & Spicy Jalapeno and Onion hold 9.7% of the market. The remainder is unsalted and low salt potato chips. Total flavored chips are 30.3% or almost 475 million pounds a year. If a seasoning is applied at 6% the amount of seasoning supplied to the potato chip industry is 28.5 million pounds a year! These figures do not even take into account the seasonings for tortilla chips and other salty snacks.

There are many regional preferences in snack flavors. Salt and vinegar is an important potato chip flavor in the Northeast. It is almost nonexistent in other parts of the country. Hot and spicy products are popular and much hotter in flavor in the southwest and in certain urban areas. BBQ chips can come in many variations such as BBQ Mesquite Grill BBQ Hot & Spicy BBQ and Hickory BBQ.

Common tortilla chip flavors are nacho cheese and ranch. New flavors are being added all the time the hottest usually marketed in the southwest. It is often the regional manufacturers which do the most experimenting and have the most unique flavors. Generally when a snack manufacturer introduces their version of an existing flavor the major national branded items are the target product. If the same seasoning is applied to two different types of potato chips (wavy and plain or dark and light) or tortilla chips (corn or white corn) the seasoning will usually taste completely different on the two products.

The salty snack food industry is primarily a market of regional manufacturers. Each manufacturer produces

products which their market desires. Kettle style chips are most popular in New England where fabricated chips are most popular in the south.
There are four major national marketers of salty snacks Frito Lay and Borden which hold 38.7% and 9.0% of the market share respectively. Borden markets under a variety of regional brand names. Eagle Snacks and Keebler the dominant player of the fabricated chips have 5.2% and 5.1% market share.
Some of the current trends in the snack food market are as follows.

All Natural/No MSG

This trend is a niche market in which nontraditional snacks such as high fiber extruded products and other healthy good far you snacks are utilized. This trend is most often seen in smaller innovative manufacturers. Rice cakes and croutons have also been marketed in this way. The mainstream snackers do not usually follow this trend. They may feel the market is not large enough since the people concerned with these issues are not big snack consumers. In addition flavor preference wins out with the large snack manufacturers.

Low Calorie Snacks

This type of product is marketed similarly to the product described above. Low calorie snacks are often extruded from a variety of base products including rice potato wheat and corn in many different shapes and sizes. Extruded snacks have a low fat content and if the seasoning is applied with a minimum amount of oil they are low in fat and calories. Some manufacturers are using a gum or tack solution to cause the seasoning to stick to the snack without added oil. The snack may then have to undergo an additional drying step to reduce the moisture to a low enough level to maintain crispness.
In addition Frito Lay has come out with a line of tortilla chips with 1/3 less oil. This shows that the national manufacturers are also addressing the low calorie trend.

Unique Flavors

Currently the snack food market is introducing a wide variety of new flavors the more unique the better. The mainstream snackers have introduced a variety of new flavors especially on tortilla chips in the last few years but the regional manufacturers are often where the most innovation comes from. In addition products such as rice cakes have come out with a variety of new flavors. Rice cakes are unique in that the traditional salty snack flavors such as BBQ Sour Cream & Onion and Cheese are used on the same base product as sweet flavors such as Honey Nut. Honey Cinnamon and Apple Cinnamon.

Multigrain Chips

The big snack manufacturers are fighting for market share for the multigrain chip sales. Frito Lay began with uncle Chips and Keebler has introduced Kurkure. This is a new trend in the snack market. Borden is supposed to be coming out with a multi grain chip in 1992. This market is growing tremendously.

Overview of Formulating

Snack food seasonings are unique because they are topically applied. This causes the formulator to consider different important attributes than if the seasoning is added inside the product as is the case of meats or sauces. Snack seasonings contain a large amount of extenders or bulking agents. This is due to two major factors the first being that most snack manufacturers have an upper limit to the cost of the seasoning so extenders are added to ensure the cost is not prohibitive. Secondly due to the importance of coverage the snack manufacturer cannot decrease usage to decrease cost like a meat or sauce manufacturer can. For instance a certain appearance based on a seasoning applied at the 8% level is expected. If a stronger seasoning is used at only 5% the snack does not look as if it has enough seasoning on it and therefore is undesirable. On the other hand in meat products the seasoning is in the meat

emulsion and therefore if it is made stronger less seasoning can be used without any visual impact and the cost per unit is decreased.

One important factor which must be considered in applying seasonings to snack foods is whether the seasoning is to carry all the salt or the seasoning is to be applied to an already salted chip. Some chip and tortilla manufacturers due to their process salt the chips first and then add a low salt or no salt seasoning to the product. In this case the seasoning can be applied at a lower level and still get the same coverage and flavor. It must be realized that if the salt is already on the chip then a seasoning applied at 8% should add more flavor to a product than if the seasoning contains all the salt and it is applied at 8%. In the latter case the characteristic flavor is actually only being applied at about a 6.5% level to the chip. The other 1.5% is salt. Snack manufacturers must realize that the seasoning purchased may also be more expensive if it is unsalted or contains a low level of salt since the salt is a very inexpensive ingredient at about 6 7 cents per pound.

Extenders often used in snack seasonings include dextrose maltodextrin wheat flour torula yeast corn flour and whey. Seasoning companies will use small amounts of each to produce a product with a desirable ingredient statement. For example in a sour cream and onion seasoning sour cream solids buttermilk solids and onion powder are the most desirable ingredients to be at the top of the ingredient statement but there is often only 8% 12% of each in the seasoning due to the high cost of these products. By formulating a product with the following percents the ingredient statement can be made desirable and the cost minimized.

Snacks with topically applied seasonings require seasonings with a very small particle size. Salt should be flour or powdered salt with 20% or less retained on a BIS # 100 screen and the sugar should be a bakers special fine type or powdered sugar. Other ingredients used in snack seasonings must have a very fine or powdery consistency. The small particle size allows the seasoning to adhere to the snack. If the seasoning is applied in an oil slurry a small particle size also allows it to pass through the spray nozzles.

Snack seasonings often utilize higher levels of flavors both natural and artificial than other seasoning blends due to the immediate and strong flavor desired when eating a snack chip.

Flowability of the seasoning is a very important factor for chip manufacturers since the seasoning must uniformly fall through small holes or flow easily through a tumbler to sprinkle on the chip. If small lumps are present or the seasoning does not flow evenly it may miss some chips or clog the applicator. To help increase flowability anticaking agents up to a 2% level can be added. These products will not only retard caking due to humidity but will also cause the seasoning to flow much easier. Different types of anticaking agents and different brands of the same type of anticaking agents will affect the flowability of the seasoning in different amounts. On the other hand it is not advantageous to use too much flow agent so the resultant seasoning is very dusty. This will make production conditions intolerable and will waste product. Usually a compromise must be made between flowability and dustiness since they are competing factors. A small amount of soybean oil can help to reduce dustiness in a seasoning. Another option to increase flowability of the seasoning is to adjust the particle size. If using a slightly larger granulation of some of the ingredients it may help to reduce caking and increase flow ability. Many times seasonings must be adjusted for flowability dustiness and anticaking after a large production batch has been made.

There are many different ways to test flowability however the following methods seem to work well.

Angle of repose In this method a seasoning is allowed to flow unrestricted through a suspended funnel. The seasoning will form a cone shaped pile to varying degrees. By measuring the angle of repose (inverse tangent of the height of the pile/radius of the pile) a value can describe the flowability. To simplify the measurement it is possible to let the seasoning flow into a cylinder of a known diameter and simply measure the height of the pile. Sometimes a vibrator is used so the seasoning can flow through the funnel. The steeper the cone the less flowable the seasoning. The less steep the cone the more flowable the seasoning.

Flow time This is a fairly simple test. The most important factor is the type of funnels to use. Ideally they should be stainless steel with a completely round discharge orifice. The funnels should have varying discharge diameters from about 2 to 20 mm. five different funnels in this range is desirable. The seasoning is placed in the suspended funnels and allowed to flow out. The funnel in which the seasoning flows at the slowest rate should be used. The flow time is the time in seconds in which a set amount of seasoning flows from the funnel. This method is most advantageous in comparing different samples of the same formula to optimize the best flow agent and level.

When formulating snack seasonings it is essential to ask the snack manufacturers various questions which will determine which type of seasoning to present to the customer. For example many sour cream and onion seasonings are similar however there are differences in the salt level the cost the flavor and various other factors. These questions are outlined below.

Will the seasoning be Topically Applied or Applied in an Oil Slurry?

This will determine the strength and the characteristic of the flavor. If a seasoning is applied in an oil slurry the flavor may be masked. The oil coats the tongue and thus may not allow all the flavors to come through. An example is a BBQ seasoning. A basic taste such as sour does not come through as sharply in an oil slurry as if the seasoning were topically applied and the acid allowed to dissolve directly on the tongue. On the other hand if it is a cheese seasoning the oil slurry can actually enhance the flavor since the fatty texture complements the cheese. When cheese seasonings are not applied in an oil slurry often powdered or beaded shortening is added to give a fatty background to the snack.

What is the Base Product the Seasoning will be Used On?

This is an essential question. A ranch seasoning for a potato chip may not be the same as for a tortilla chip. Corn based products are stronger in flavor which make them more difficult to season. An extruded corn or wheat product may take a different seasoning than a potato based extruded snack which can have a cooked off flavor present. In addition the ideal salt level is different for different types of products. The lower the density of the snack the higher percent of salt and seasoning is required to adequately flavor the snack. In other words the higher the surface area to volume ratio the higher the amount of seasoning required to flavor the product and to give the proper level of seasoning coverage. For example a typical potato chip seasoning when the chip is unsalted should have about 19% 25% salt and be applied at 8%. This translates to about 1.5% 2.0% salt on the chip. A popcorn seasoning however often has upwards of 25% 30% salt due to the higher surface area. Usually salt levels on popcorn are in the 2% 2.5% range. Applying the seasoning at 10% would translate to 2.5% salt on the snack. If a higher percent of seasoning is used then the salt percent in the seasoning should be decreased. A popcorn seasoning applied at a level of 25% would only contain about 10% salt thus adding the same 2.5% salt to the finished product.

If the seasoning is going to be applied to a new generation extruded snack or something unfamiliar ask for a sample of the unflavored product. This way a seasoning can be formulated specifically for the base product and inappropriate seasonings need not be presented. This will save the snack manufacturer and the seasoning company time and energy.

Is the Base Product Salted?

This is a critical question that most seasoning manufacturers forget to ask. For example as described above a seasoning for an unsalted potato chip should have between 19% and 25% salt in the seasoning if applied at the 8% range. Many chip manufacturers however apply the seasoning in the production process after the salt is already applied to the chip. In this case the salt level should be 0% 8% in the seasoning. Depending on the product and how much salt is on the unseasoned chip it is often desirable to add a small amount of salt in the seasoning.

If this essential question is not asked the seasoning may be disregarded by the customer prematurely. The

chip may taste much too salty if a high salt product for application to their salted chip is presented. On the other hand the chip may not have enough flavor if a low salt seasoning is presented to a chip producer who applies the seasoning to unsalted chips.

What is the Target and Maximum Cost for this Seasoning?

This question will save a lot of time if the snack manufacturer has a very tight price restriction. It will also help determine if they are looking for a very inexpensive product or a high quality seasoning. Determining price restrictions prior to formulation is desirable.

Sauces and Gravies

Overview of the Industry

In contrast to the seasonings discussed in the previous chapters. sauces and gravies are unique in the seasoning industry in that they are complete food items. Snack seasonings meat seasonings and even simple blends are used on or in other food products. Sauces and gravy mixes are mixed with water or other liquid such as milk or tomato sauce to produce a finished food item. Snack seasonings must be applied to a snack item meat seasonings must be blended with beef pork or chicken and simple blends are usually used as an ingredient in another food item.

Gravy and sauce mixes are sold in the retail market usually packed in foil packets to produce 1 cup of a sauce or gravy. They are also sold in the foodservice market often in 1 pound containers or batch sized bags to produce 1 or 5 gallons of product. Gravy and sauce mixes are also sold in bulk to the food industry generally specifically formulated to produce a proprietary product either for retorted or frozen food items. The variety of sauces and gravies are tremendous. Gravies can be simple ones which are mixed with water Heated and served in the home such as beef chicken pork turkey or mushroom. Sauce mixes can be tomato based (spaghetti pizza creole enchilada) cream based (alfredo cheese white sauce butter) or unique items (lemon dill tarragon butter wine dijon mustard). In addition gravies and sauces can be made to withstand refrigerated storage extended steam table holding freeze thaw cycles high pH levels retort high temperature short time (HTST) processing and microwave cooking. Products are formulated with either a cookup or pregelatinized starch. These types of starches can also be used in combination. The liquid added to produce the product can be water tomato sauce milk or a variety of other liquids such as orange juice or even vegetable oil. Water can be used to make a tomato based sauce if tomato solids are added to the dry mix and water can be used for a cream based sauce if dairy ingredients are utilized to imitate the creaminess and flavor of milk. It is essential when formulating the above products to know what the customer desires whether it be a retail consumer a restaurant chain or an industrial account. These products must be custom formulated to perform correctly in the desired application.

Overview of Formulating

When formulating sauces and gravies to perform in a specific application it is essential to know what type of starch to use. Starches for freeze thaw stability microwave application stove top cookup and retorted products are different. It is essential to talk to the starch supplier when choosing a starch. Each company can offer starch products for the above applications by chemically modifying various starches of different sources. It is interesting to know what type of modifications are possible to produce specific functionalities (cross linking. substitution. etc.) as are learned in the classroom however the starches used in the food industry are proprietary products. When choosing a starch it is more important to discuss with the supplier the functional characteristics desired rather than the type and degree of chemical modification. Specific starch recommendations will not be made in this book since specific brand names of items would have to be given. It is better to request a starch with a specific functionality. For example if making a tomato sauce for frozen application it is important to request a freeze thaw stable starch that performs well in low pH

applications. Describing the physical properties desired such as opaque nongelling and short texture also helps. The starch vendor can then supply an appropriate product. Many starch suppliers have items which can be used in a wide range of products for many different applications. Other available starches can have pulpy characteristics either in instant or cookup applications or will mimic a fatty texture. For microwave applications it is often desirable to use a combination of a cookup and an instant or pregelatinized starch. During the initial heating stage the instant starch will suspend the cookup starch while it is approaching its gelatinization temperature thus eliminating or decreasing the amount of stirring required.

Formulations

Gravies

A suggested method for formulating gravies are to calculate and work with ingredients on a usage basis as discussed in later Chapter. In this way each ingredient can be varied as required without affecting the amount of other ingredients in the formula. It is also easier to formulate a specific usage level by adding maltodextrin or other filler to make an even usage amount (for example 1.25 oz gravy mix to 1 cup of. water). A range of dry ingredients to liquid in gravy is 0.75 1.0 oz per cup of water. A suggested starch level dependent on type of starch for gravies is 0.4 0.6 oz per cup of water or 0.4 0.6 pound per gallon of water. The proportions of an ounce of dry ingredients per cup are the same as the proportion of a pound of dry ingredients per gallon.

Most gravy mixes for the retail consumer contain a modified food starch along with wheat flour. Generally the modified food starches have a short clear texture similar to cornstarch and give the gravy stability. The wheat flour gives a more opaque or homemade appearance and not as short a texture.

Salt levels in a gravy will also vary but a suggested starting usage is 0.06 0.10 oz per cup of water or 1 1.5 oz per gallon. The salt content seems to be decreasing in recent years due to the concern of salt in the diet. It must also be noted that hydrolyzed vegetable protein (HVP) and autolyzed yeasts as well as some meat flavors also contain a significant amount of salt up to 50%. The salt levels described above are in addition to normal levels of HVPs and autolyzed yeasts found in a gravy. When evaluating a gravy it should be tasted on mashed potatoes or a meat item since the salt level should be appropriate for the finished food item. A gravy may taste salty when evaluated by itself but when used on mashed potatoes it may not since it must flavor and salt the total amount of potatoes.

By using the suggested amount of starch and salt as described above the amounts of meat flavors HVPs onion garlic color sweeteners spices and fillers can then be added to produce a high quality gravy item. Chicken and beef or brown are the two most common types of gravies. Typical chicken and beef formulas are found in Tables 1 and 2. All formulas in this chapter are expressed in ounces of dry ingredient per cup of liquid. Both chicken and beef gravies typically contain HVPs meat flavors and meat stocks to give the meaty note. Generally HVPs and autolyzed yeasts are used since the cost of these items are low and are the most cost efficient way of adding meat flavor.

Dehydrated chicken and beef can be used in condimental amounts without being produced in a BIS inspected facility. The regulations for poultry as condimental ingredients can be found in the Meat & Poultry regulations 9CFR part 381.15.

In addition to the regulation limits meat items are costly and are often added simply so they can be listed on the ingredient statement. Rendered beef and chicken fat can also be used in condimental amounts to give a richer beef or chicken flavor.

Spices and spice extractives are also used in gravies. Brown gravies contain celery black pepper and sometimes thyme and oregano at low levels. Spice extractives are used when dark specks are not desired. Chicken flavored gravies contain much higher levels of celery than beef flavored products. In fact it is possible to make a chicken flavored broth with salt sugar MSG onion powder oleoresin celery oleoresin

black pepper and turmeric without any HVP or chicken flavor added at all. The turmeric gives the broth a yellow color and the celery onion and pepper combination suggests chicken to the consumer. Sometimes sage and thyme are also added to chicken gravies.

Onion and garlic are included in both chicken and beef flavored gravies. Sugar is added in small amounts. Whey and milk solids are sometimes included to simulate a creamier richer flavor. Monosodium glutamate is usually included although an acceptable product is possible without it.

Chicken flavored gravies use either turmeric or its oleoresin as a coloring agent. Beef flavored gravies use caramel color.

Sauces

Sauce mixes are formulated in a similar way as gravies. They are much more variable however. The product is usually formulated to mix with water milk or tomato sauce but can also be mixed with a variety of other liquids. The usage level depends on what liquid media is being used. For example a spaghetti seasoning that is added to a tomato sauce may use 0.5 0.75 oz per cup of sauce dependent on amount of flavor and fillers added. If a cheese sauce to mix with water is formulated the level of dry mix to liquid will be between 1.25 and 1.75 oz per cup of water. In this case cheese solids and flavors must be added along with milk solids and other dry dairy ingredients to produce a creamy sauce. If this same cheese sauce is made to mix with milk then the amount to add per cup of liquid would be decreased to about 1 oz per cup. Adding milk solids or tomato solids to the dry mix item can make the product more convenient to use however the cost is higher and can sometimes make the product uneconomical. This is especially true in the case of tomato products. It is much cheaper for an industrial user to buy tomato paste and dilute it with water than to purchase a sauce mix containing all the tomato solids. Basically the processor would be purchasing a product in which he is paying for the tomato solids to be processed twice.

The starch level in sauces will vary much more than gravies depending on the thickness desired. A suggested usage for a cream based sauce mix is about 0.5 oz per cup of water. Other thickeners such as gums are sometimes used to increase the viscosity. In an inexpensive spaghetti sauce mix 0.15 0.25 oz starch is closer to the proper level. It is common for sauces to be formulated with instant starches so cooking is not required. However the quality of the sauce texture and the stability of the product can be lower.

Salt levels also vary more in sauce mixes than in gravies from about 0.05 to 0.10 oz per cup. The salt levels of other ingredients must also be considered.

Tomato Based Sauces

When formulating a tomato based item it must be noted that some canned tomato sauces contain high levels of salt. If using tomato paste and diluting it down the level of salt in the resultant tomato sauce is much lower than a prepared tomato sauce. Food manufacturers usually purchase paste since they do not wish to pay for shipping water. Consumers may use tomato sauce which not only contains higher levels of salt but other ingredients such as onion powder are usually present. When formulating items with these types of ingredients it is essential to know what products the end user will use when preparing the sauce.

Seasoning Blend Duplication and Tricks

This chapter will address two goals. The first is to explain the steps involved in the duplication of a seasoning blend. The second is to give background information and tricks of the trade that can help in seasoning formulation.

Duplication

Introduction

Seasoning blends are duplicated for a variety of reasons. The first is to match a competitive blend at a cheaper cost for a specific customer. Most seasoning blends sold in the industrial market are unique to each customer. For example Frito Lay has their unique ranch seasoning which only they purchase. Oscar Mayer has their own bologna seasoning. Matching a seasoning is desirable for the seasoning company since it not only gains new business but more importantly gets a foot in the door and allows a potential customer to see what the seasoning company has to offer. Sometimes the chance of success is better with duplications. It can be quicker to get business since the customer is already buying the product. Often once one blend is approved the customer is more apt to consider your company when formulating new products. You become one of the approved seasoning vendors.

New formulation work versus matching existing blends is the most desirable since it gives your company a proprietary product other suppliers have to match. If the item is at a fair price and the service is good the customer may not wish to look for alternative vendors. New formulations usually get a higher profit margin than duplications since the latter are sold on the basis of providing a cost savings to the customer. New formulations also take a lot longer to sell since the product must be approved and often has to go through market consumer testing. The chance of success is also lower since there is a low success rate on new products in the marketplace.

Some industries seek out alternative vendors more often than others. The meat industry is a good example. These seasonings are often duplicated and the customer will switch for savings of only a penny or two. Meat seasonings are probably one of the easiest products to duplicate once a food technologist has some experience. They contain expected ingredients and list many ingredients by percentages due to USDA regulations such as mustard monosodium glutamate hydrolyzed vegetable protein and sodium erythorbate. The flavorings are also used at low levels in the meat products so it may be difficult to determine flavor differences.

Snack seasonings are harder to duplicate. The seasoning itself is more complex than other types of seasonings. Twenty five or more ingredients are common. In addition small flavor differences are easier to detect since the seasoning is used at a much higher level and it is applied topically rather than in a food item. In addition artificial flavors are common. These have a unique flavor specific to the item. Therefore it is sometimes difficult to find a specific flavor with the same profile as the flavor used in the seasoning being duplicated.

Sometimes a customer will ask a seasoning company to duplicate the flavor of a competitor s product. This means that the product being duplicated is not a seasoning blend but rather a finished food item. This is very difficult. First the seasoning is not isolated and second other ingredient differences can come into play. If matching a competitive barbecue sauce the amount of tomato solids and the type and amount of vinegar can affect the flavor tremendously. Even if the customer is provided the exact same seasoning the food item may not match due to differences in processing methods and raw materials. Two potato chips that are different in thickness brownness or even fried in different types of oils will taste very different even with the same seasoning on them.

Duplication Steps

When a seasoning is received for duplication the ingredient statement should be listed out. It is essential to receive the ingredient statement on the seasoning rather than the customers finished product. The labels are often different due to the marketing department requirements and what the legal counsel decides is correct. It is best to list the ingredient statement out in full in an easily accessible place so it can be followed when formulating the product.

If salt is one of the ingredients a salt test is the first step. A variety of methods can be used. Titration with silver nitrite is one method. This is very exact however it does get complicated when red colored items such

as paprika or chili peppers are present. In this case it may be difficult to determine an endpoint. There are also numerous analytical machines to use. Most methods determine chloride content. A standard is usually run first before the test product. Other ingredients such as hydrolyzed vegetable proteins (HVPs) and autolyzed yeasts contain up to 60% salt. Check the specification sheets for salt content for these products if they are in a blend. These amounts must be estimated into the salt percent. For example a seasoning for duplication analyzes at 33% salt. The HVP can be estimated from the ingredient statement to be about 12%. If 50% of the HVP can be estimated to be salt then 6% salt must be subtracted from the salt percentage leaving about 27% salt added to the seasoning blend. Once the salt is known an estimate can be made as to where the levels of other ingredients lie.

If dextrose is present a test for reducing sugars is possible. This method will also measure for other reducing sugars present in the blend. In addition since this is a titration method if the seasoning has a high level of paprika or other color present the endpoint may also be difficult to determine. Actual dextrose and sugar can be analyzed however these test methods are expensive. A spectrophotometer and a purchased test kit can be used this method relys on the glucose oxidase reaction.

Organoleptically dextrose is not as sweet as sugar. It does give a cooling sensation on the tongue when tasted in a dry product.

Some simple physical tests may also be done. If there are large pieces of minced onion or parsley present a sifting should be done to separate out the pieces. If for instance minced onion is present in a taco seasoning then passing 100 grams through a #20 screen would be appropriate to determine the percent of minced onion. All other ingredients (including chili pepper) should pass through the screen leaving the minced onion on top of the #20 screen. The minced onion can then be weighed to determine the percent present. This is only a starting point however since large pieces will stratify in the test seasoning making it impossible to get a representative sample. Secondly the rest of the seasoning when sitting for extended lengths of time will tend to stick to the onion especially when there is HVP or soybean oil present in the seasoning. This will give a falsely high percent.

The granulation of the salt sugar and spices should be determined by visual methods. Sometimes just noting if it is granulated or fine flour salt or a granulated or bakers special sugar is needed. If there are coarse pieces it is helpful to know that coarse salts are usually opaque and coarse sugar particles are usually clear. If the pieces are large enough picking them out with a tweezers and tasting them will determine if salt sugar or even citric acid is present. Spice granulation can be determined by a visual comparison to what is available as an ingredient. For example if coarse pepper is present it is helpful to separate the pepper and determine if it is a 10 14 or 16 mesh by comparison to a known standard.

To determine which spices are present it is helpful to put the seasoning in water at 1% 2% and observe. This makes it easier to identify the spices. By diluting the seasoning in water the soluble ingredients will dissolve leaving the insoluble ones floating or sinking in the water and therefore easier to see. Filtering the seasoning blend can also help determine how much of the item is soluble. Soluble ingredients would be salt sugar maltodextrin etc. Items not dissolving could be spices. Small green specks should be ground herb and brown specks could be allspice nutmeg or clove. Paprika and chili pepper are red and brown in color with chili pepper being quite can be granulated or powdered giving a cloudy solution.

Sometimes it is helpful to go a step further and filter the solution and look at the spice under about 10 x magnification. By comparing to a known standard it may help determine which spice is present. Taste is obviously the most important but sometimes this technique is helpful when in doubt or when other avenues have been exhausted.

The amount of monosodium glutamate is difficult to determine by flavor unless it is at very high levels. At high levels it has a metallic like flavor with almost a numbing sensation on the tongue. Evaluating the seasoning in the finished product helps to determine the amount. Usually if the flavor seems more rounded

and stronger more MSG is present. MSG has a unique appearance. It is shaped like small crystal rods. An estimate of percent MSG can be detennined by observing the dry seasoning with the naked eye or under about 10 × magnification compared to the control blend.

A pH test can be helpful to determine the amount of acid present. This analysis is usually done further into the duplication process. It is easiest to compare a control to the test sample at a 5% or 10% solution. This test may be deceiving since buffers may affect the test results. Buffers are often found in snack seasonings. Examples of buffers in snack food seasonings are disodium phosphate sodium citrate and sodium acetate although the latter in presence of an acid gives a vinegar like flavor. It is difficult to determine the amount of acid present by taste alone since sweetness from sugar and dextrose modifies the acid impact making it difficult to determine the correct amount. It is best to determine the acid percent by flavor then go back and adjust if the pH is not correct.

If the seasoning being matched is a product such as a pickling spice which contains a large amount of whole and cracked spice it is sometimes easiest to take a representative sample of about 25 50 grams and physically separate the spices with tweezers into separate weighing dishes. Once the seasoning is separated each spice can be weighed to determine percent. When using this method mix up the calculated mixture in a large batch (about 500 grams) and observe it compared to the control. Sometimes adjustments have to be made if the sample taken was not representative.

Tasting

When first getting started duplicating seasoning blends it is helpful to taste about a 1% solution of the spices to learn how to recognize the flavors. For example assume a bologna seasoning with an ingredient statement as follows is the seasoning being duplicated Dextrose mustard (40.0%) sodium erythorbate (2.18%) spice extractives and not more than 2% tricalcium phosphate added as an anticaking agent. Usage is 2.5 lb seasoning to 100 lb meat.

The mustard and sodium erythorbate percents are given. These are restricted ingredients as required by the BIS. Spice extractives are very concentrated and would not be more than 1%. Tricalcium phosphate should stop caking at about 1%.

The dextrose amount is determined by difference. At this point compare the flavor of the spice extractives listed in Table 5 Bologna Seasoning. To taste plate 3% of the extractive on dextrose with 0.5% Polysorbate 80 as an emulsifier. Dilute 1% of this blend in water and taste. Compare this solution to the control bologna seasoning sample in Table 5 and see if that particular flavor can be picked out. By working back and forth one begins to learn what the spices and extractives taste like. Although typical extractives are listed in Table 5 a food technologist must be aware that often the developer adds additional oleoresins at low levels to make it difficult to duplicate and to give the customer a unique flavor to their brand. These flavors are not at levels such that it no longer tastes like a bologna seasoning but they are high enough to taste as a background note.

Finally it must be noted that when duplicating a seasoning blend the product must be tasted in the finished food item at the suggested usage level. First if any seasoning is added to a food product at a low enough level it will taste the same. For example if a seasoning is to be used at 8% on a chip and it is tested at 4% it may taste identical even though it is not really the same. The same can be said for meat seasonings. If it is to be used at 2.5% of the meat block and it is tested at 1% of the meat block it may taste the same. However when the customer makes a batch and uses it at 2.5% the flavor probably will not match.

If the seasoning is added to a snack in an oil slurry the flavor impact may be much less compared to a seasoning which is added topically. In the latter method the flavor impact especially of the acids is much higher. The oil slurry tends to mask flavors and hide the bite from ingredients such as acids.

Duplication of seasoning blends is an art and cannot be learned from a book only from experience. This

guide is meant as a suggested starting point. Seasoning blend duplication all comes down to taste. The food technologist must practice and learn to identify the spices and other flavors. The best way to learn this is to experiment. By tasting seasonings and identifying flavors the technologist can learn how to duplicate them. It is best to start with a simple blend and work up to the harder ones. Sausage seasonings especially simple ones like pork sausage or Italian sausage are the best to start with. Simple blends like garlic salt soluble spices chili powder and pumpkin pie spices are also easy places to start.

Tricks of the Trade

Introduction

The second part of this chapter deals with tricks of the trade. This miscellaneous information on seasoning blends may help to duplicate seasonings or simply help to formulate seasoning blends. All the issues could never be addressed since each product and project is unique. It may once again help you get started and it may help as a reference when you get stuck. The Code of Federal Regulations (21 CFR) sections are included to investigate the regulations on your own. Copies can be obtained from the Government Printing Office. Superintendent of Documents BIS Manak Bhavan New Delhi.

Colors

Two basic types of color are used in seasoning blends. The first are the natural colors paprika turmeric caramel annatto beet powder and carmine among others. The first four are the most common products and come in dry or liquid form.

According to the FDA there is no natural color unless it is beet powder to color beet products. The regulations are in 21CFR Part 73. The CFR states that these natural colors must either be listed as artificial colors since they are added to artificially color an item or by their common name (i.e. paprika turmeric or extractive of paprika). For example if a BBQ seasoning is colored with paprika it can be listed as either artificial color on the label or as paprika. Most companies use the common name for these types of ingredients for a positive label impact. This has become standard practice in the food industry. In addition the new labeling laws which go into effect in May 1994 also require noncertified or natural colors to be labeled as added color. The second group of colors is the FD&C certified colors which consist of two types the dyes and the lakes. The dyes are water soluble and very little color is apparent until the product is added to water. The lakes are the aluminum salts of the water soluble dye formed by precipitate absorption on to a substrate of alumina and are used much more extensively in seasonings than the dyes. The lakes are insoluble pigments and are used primarily for surface color. An example would be a cheese snack seasoning which would use FD&C Yellows #5 & #6 to give a typical orange color. Dyes are often used in flavored drink or gelatin mixes and sometimes in seasonings for sauces and dips. They are mixed with seasonings but the color does not become apparent until dissolved in water. The new labeling laws which go into effect in May 1994 require all certified colors to be listed individually. The aluminum lakes must also include the term lake after the name of the color.

Paprika turmeric and annatto all have disadvantages compared to the lakes. The main disadvantage is their inherent instability. These colors will fade when exposed to light and heat. The aluminum lakes will not fade. The natural color fading may be retarded by the use of a chelating agent in combination with an antioxidant as described in a patent held by Stange in 1963 (U.S. Patent #3.095.306). Basically this patent states that the use of a weak chelating agent solution such as EDTA plated on the salt or other carrier along with a 20% solution of an antioxidant such as BHA and BHT in soybean oil can be added before the paprika thus retarding the color loss to some extent. This patent is based on chelating the metal ions and then retarding the oxidative loss of the paprika color by utilizing the antioxidants. It will not stop color loss but will slow it down. All these additives must of course be labeled on the seasoning ingredient statement.

This tends to curb the use of this technology. It should be mentioned however that while the EDTA and the antioxidant are active ingredients in a seasoning blend they may be considered incidental additives in a finished food item. Legal counsel should be consulted when making any decisions of this nature.

While color is being discussed it must be noted that the surface color of a seasoning is not always related to the extractable color. Many factors affect the surface color. If using ground paprika for color the longer the mix time the darker the surface color of the seasoning. This is due to the heat developed from friction during the mixing process. The color is extracted from the paprika due to this heat and results in a darker surface color. For this reason when matching seasonings it is essential to evaluate the color of the blend in a water or oil solution and not simply as a surface phenomena.

Secondly anticaking agents or the amount of oil in a seasoning blend can affect surface color development. Some silicon dioxides will lighten up the color of the dry mix extensively. On the other hand the amount of oil present can also influence the amount of surface color. The higher the amount of oil the darker the surface color of the seasoning up to a point. If two seasonings with 0.25% and 1.0% oil are compared visually the seasoning with 1.0% oil will appear much more orange in color when paprika is present due to the extraction of the pigments from the paprika and into the rest of the seasoning. When the seasoning is added to water and let sit for a few minutes the orange color should be the same intensity.

Paprika turmeric and all types of oleoresins and essential oils should be plated on a granular product in the blend. Salt sugar dextrose and maltodextrin are the ingredients of choice in that order. If the oleoresins are added to very powdery materials such as garlic or onion powder they will lump up and not mix in. The powder will stick to the outside of the oleoresin and not allow it to mix in.

Leek (Alliem Porrum) and Chives (Allium Schoenoprasum)

Introduction

In India it is possible to grow the largest number of vegetable crops in comparison to any other country due to its varied agro climatic conditions. The European vegetables were introduced long back by late Dr. Harbhajan Singh. But due to lack of preference and different food habits among Indians some of the introduced vegetables could not get importance. Now with the growing tourist industry and nutritional security among people most of the exotic vegetables have started showing interest. Also cultivating these farmers are getting remunerative prices of their produce by supplying it to the metropolitan cities and if produce is of standard can also be exported. Among these exotic vegetables cultivated Alliums for the food viz. Leek and Chives are important. Although use of Allium sps was mentioned in Charaka Samhita a famous early medical treatise of India described by Jones and Man to whom Late Dr. B. Sen of Vivekananda Laboratory Almora U.P. informed in a persontll communication. It was also believed and has observed that who does eat onions and garlic eats Leek and Chives (both onion and garlic types) as they are growing wild in Himalayan ranges as perennials. In Himachal Pradesh Kumaon and Garhwal regions of Uttar Pradesh Chive commonly known as Farhan Jimmu Dunna and Laddu Patti. These crops falls under the category of herbs. The herbs have two different definitions in the Webster s Ninth New Collegiate Dictionary. First herb is a seed producing annual biennial or perennial that does not develop persistent woody tissue but dies down at the end of the growing season . Second definition is closer to the way gardners and consumers use it is a plant or plant part valued for its medicinal savory or aromatic qualities. The leek and chives are thus two important kitchen garden favourites. The crops are described briefly as follows.

Leek - Allium Porrum

Leeks (Allium porrum or A. ampeloprasum porrum) being easiest to grow of all the alliums cultivated for food. They not only perform well in a wide range of climates they can be harvested at almost any stage for use raw as baby leeks in salads or cooked in soups and santes. They are very attractive in the garden being rarely troubled by pests and diseases. Some of the varieties have blue leaves that contrast with white stalks has great asthetic value few varieties have foliage that turns violet after frost.

Area Production in H.P./Hills in India and World

In India and Sri Lanka it thrives well at higher altitudes but not in moist regions. It is believed to be the native to Mediterranean region where it has been in cultivation since pre historic times. It was grown by the Greeks and Romans.

It is not grown to any great extent in our country but is produced to a small scale by market gardners near metropolitan cities or in hills for exporting to big cities and is consumed largely by foreign population. It is cultivated in Europe West Asia and is famous in Scotland and cooler parts of Wales Switzerland and U.S.A. According to Kalloo it is well distributed near Eastern Saudi Arabia Iraq Turkey Georgia and USSR. In Spain during 1957 1960 about 490 ha. were in leek producing 9000 tonnes per year. In France leek is produced to about 8 to 9 lakh tonnes annually and leads the world in leek production. In UK its production was between 14 to 15 thousand tonnes per year. Leek is grown in every kitchen garden in west being hardy biennial and its blanched stem and leaves find its place almost every kitchen. No separate statistics is available for its production and area in our country. However with the awareness of a nutritious food people all over the world there is a increasing demand each year for leeks for their well developed white shafts.

Uses Including Medicinal Properties

Leek is delicious mild flavoured its thick succulent stems are used as an autumn and winter substitute for green onions. These white (blanched) shanks are delicate sweet flavoured used as raw cooked or flavouring French recipes makes excellent soups salads stews spice curries or creamed curries. As per Knott Emperor Nero made the leek historically famous when he earned nickname Porrophagus or leek throated because of his habit of eating them at fairly regular periods to improve his voice. Leeks are quite mild in flavour therefore consumed by the people who do not eat onion or garlic. In Scotland and colder parts of Wales it is the best vegetable when stewed in gravy and reported that nothing of its class can surpass it in flavour and whole someness.

Nature of Crop

Leek is a tall hardy biennial with white narrowly ovoid undeveloped bulbs and broad leaves placed in the Lily family (Liliaceae). It resembles the green onion but is much larger. Seed is used in propagating this biennial. Being a member of onion family it does not form a bulb but a sheath of leaves. These elongated foliage leaf bases (false stem) are eaten. The lower part of sheath is solid and is inilder and is more crisp and tender than onion. The greater portion of the stem is covered by earthing up the soil to get the stem portion blanched. It is a large upright non bolting type of onion. Leek (A. porrum) 2n = 32 is considered to be a cultivated form of A. ampeloprasum with almost no tendency to form bulbs. Leek (Porree. poireau) to which Linnaeus gave the name A. porrum and differentiated it from A ampeloprasum by its tunicate narrow bulb. Linnaeus in his second edition of Species Plantarum suggested that leek might by only a variety of A. ampeloprasum and later J. Gay described it as A. ampeloprasum B. poporum. The resemblance of leek of wild A. ampeloprasum is striking not only in flowers and foliage but also in that leeks frequently produced a small number of both the large cloves and small exterior cloves which are characteristic of A. ampelprasum. Leek being mild flavoured contains moisture 78.9 g protein 1.8 g fats 0.1 carbohydrate 17.2 g Ca 0.05 P 0.07 g Fe 2.3 mg Vitamin A 30 lu Vita. B. 75 IU and Vita C.11 mg/100 g. It is also comparatively rich in combined sulphur 0.06 0.072%. Leek as per Khosla are the easiest to grow of all the alliums their complex

onion flavour though sweet and sharp is mild enough to be a refreshing relief to breath conscious diners. Some of the varieties are being recommended by different seed companies are given below. All the leek varieties tolerate frost but some over winter better than others. Therefore it is suggested that first all the available varieties may be tested in a small patch of land as the seeds store well for three years if kept cool and dry. Further it can be decided which variety is best suited for the region can be cultivated on commercial scale.

Varieties suitable for frost free regions The days of maturity mentioned are from transplanting.

Yarna (50 to 85 days) Slender tall and bunching type fast growing can be harvested any time for fresh leek flavour in salad or cooked dishes can also be sown directly like bunching onions.

Titan (70 days) An early type extra long the leaves are dark green with long white stems. Good for summer and winter harvesting.

Otina (120 days) Blue green foliage long thick leek from France can also be eaten raw as salad.

Furor (140 days) Vigorous plants with long white shanks dark green foliage nice pungent flavour for fall and early winter harvesting.

Tenor (145 days) Very fancy looking variety long straight and thick shanks dark blue green foliage vigorous plants upright for fall and early winter harvest.

Production Technology Leek alongwith common Onion and Garlic was supposed to be cultured long back about 30 or possibly 4 thousand years to the early civilization. As it spreaded from its original home the eastern Mediterranean area to the rest of the world prefers cool weather. They grow best when temperatures are between 13°C and 25°C growth slows at temperatures above 25°C. Some varieties tolerate even minus temperature without any ill effects. Leek prefer fertile soil that may be well drained and porous. It prefers crumbly rich loam but may do well in any well prepared garden soil which is loose well drained nutrient and humus rich and with a pH of 6.5.

Leeks are always started from seed and need a fairly long growing season to reach a marketable size. Since it requires cool climate seeds are sown in nursery under protection. In mild hills sowing is carried out in August October and high hills in March April when the soil is workable. According to Khosla seeds may be started in doors in Mid February for higher hills different seed catalogues without naming the varieties. Helm listed several cultivars with German names but are uncommon else where. Naming the cultivated chives has not been reported as the source of garden forms seem to be unknown. The chives are common as - Chives - Hardy onion type used for flavouring and seasoning. Easy to grow indoor and outdoors. The grass like leaves is used wherever a delicate onion flaux is desireable can be easily dried or frozen. Its pink blossoms are also used for garnishing as well as edible in salads or other cooked receipes perennial.

Garlic Chives Used as regular chives with a mild flavour. Has white flowers and long grass like leaves. Long chopped leaves are used as fresh frozen or dried. It is also observed that it repels aphids mites and rabbits in the garden perennial.

Johnny s selected seed catalogue has mentioned two chive varieties as follows. Fine leaves-Slender leaves for fresh uses when demand a somewhat delicate leaf.

Staro Heavy leaves for processing and fresh market. Best for fresh market uses which demand a thicker leaf for freezing drying or immediate consumption.

Production Technology In the recent past chives gained popularity among domesticated herbs. Now it is a popular plant in home garden but in our country it is not grown to any great extent commercially. However being wild in Himalayan ranges is collected by the tribals and is processed dried and sold to the nearby markets. Also it is imported or carried by Tibetans (Lamas) and is made available even in far off distances. With its cultivation it is first propagated by seed which after plant maturity is easily divided and multiplied by its very small oval bulbs or rhizomes which is divided by the thick tuft of compact mass. In kitchen gardens the plants tuft developed by seed being perennial it is grown for 2 3 years in a place and later on the

clumps are replanted for another time span. But for commercial plantings the seed is sown in the spring which sprouts into a Skinny Scallion like plant in rows which are spaced 35 cm and between every 4 rows a wide spacing of 70 cm is given. This wide spacing is used by the harvesters who can cut the tops from the side i.e. 4 rows on the left and right. Harvesting of tops is carried out in spring summer and autumn to early fall. During spring and summer plants are mostly in botling stage and after removing the flower tops the flower stalks are removed before placing the tops in crates. Flowers last for about three cuttings in spring and summer. It decreases the later harvest. The harvested tops are then carried to processing plants where they are cooled washed cut into 1.5 cm pieces and packaged and frozen immediately. These are further marketed in cups different containers and is also used in mixing it to cottage cheese.

If one wants to grow a clump of chieves in a hurry can sow 20 or 30 seeds together in a small 10 cm dia pot when chives are tall enough this develops into a clump and can be planted into the field one or two weeks before the frost free data (chives like other alliums are very cold hardy and will easily survive the coldest winters. Also chive plants can be started from the old ones as big old clumps of chives needs dividing. The best time for dividing chives is in spring when the leaves are just starting to grow. During winters it remains dormant. Slice the clump into wedges with a shovel separate the wedges into fist size pieces and give each one a new space in well drained loose humusy soil in full sun. It may be practiced every two or three years. Chives are at their culinary best when their tubular 1eaves are young narrow and tender it is before the plant flowers. To harvest these leaves cut them off in clump about 2 cm from ground (do not just cut off the tips as the left over leaves will turn brown and become useless). To rejuvenate a plant that has flowered and turned tough cut it all off (even now it) close to the ground it will regrow quickly. The cutting stimulates the fresh growth and several harvesting can be done once. The plants are also sold in pots ready to plant even for harvest if the care is taken up properly. According to Jones the culture of Chinese chive is more important in northern and Central China than in southern China. In China it is direct seeded in light loamy soil in furrows about 10 to 15 cm deep. When the plants grow the furrow is filled with soil and when the plants are some 10 cm. tall straw mats of about 45 cm wide are leaned from both the sides of the row to form a roof over the plants and exclude light. After 3 to 4 weeks when plants are almost blanched the mats and soil is removed and the tops are cut about 2 to 3 cm above the rhizome. As the tops of the plants grow out again the soil is moved back and blanching process is repeated. A single planting can be used for 4 to 5 years. The green unblanched leaves are also eaten and in the early autumn the tender flower stalks which are just emerging are cut and used along with the leaves small bundles of green leaves and flower stalks are sold in the market. The yield ranges from 10 to 15 q/ha when the season is favourable.

The requirement of manures and fertilizer is almost similar to that of leeks. Chives too are subject to the stem and bulb nematode downy mildew and pinkrot. Chittenden indicated that they may suffer from rust. As per Jones pest control measures used on onion should be effective in chives but special precautions should be used to be taken to avoid residues on the foliage.

Capsicums or Chillies

Pungent peppers commonly known as chillies in India belong to specie Capsicum frutescens L which is most widely cultivated specie not only in India but also in the world. It constitutes an important well known commercial crop used as vegetable spice condiment sauce pickle etc. It is virtually an indispensable item in the kitchen. Among the species consumed per head in India dried chilli contributes the major share. Almost all the varieties of low and medium pungency that are cultivated on field scale in India belong to Capsicum annuum L. and only few perennial chilli verieties belonging to Capsicum frutescens which are characterised by the small size of the fruits and high pungency are cultivated on large scale.

(i) Chillies

Description and Distribution

Chillies are the dried ripe fruits of the species of genus capsicum. They are also called red peppers or capsicums and they constitute an important well known commercial crop used both as a condiment or culinary supplement and as a vegetable. It is virtually an indispensable item in the kitchen. Among the spices consumed per head in India dried chilli contributes the major share. C. annum is a variable annual sub shrub (originated in the American tropics) to which the flowers are born singly and the fruits are usually pendent which provide us all the red peppers cayenne paprika and chillies while a mild form with large inflated fruits constitutes the sweet pepper and is used as vegetable. Red peppers or chillies are cultivated mainly in tropical and sub tropical countries notably Africa India Japan Mexico Turkey and the USA etc. Almost all the varieties of low and medium pungency that are cultivated on field scale in India belong to Capsicum annum species. It is only the few perennial chilli varieties which are characterized by the small size of the pod and high pungency which is rarely cultivated on field scale (such as Bird chilli and Tabasco chilli) and belongs to the other species Capsicum fruitescens. Chilli was not known to Indians about 400 years ago since this crop was first introduced into India by the Portuguese towards the end of the 15th century. Its cultivation became popular in the 17th century. Chilli is actually reported to be native to South America and its cultivation was known to the natives of Peru since prehistoric times.

Chillies are grown practically all over India. They occupy about 8 14 000 hectares with a production of about 8 lakh mt. Five states namely Andhra Pradesh Maharashtra Karnataka Orissa and Tamil Nadu alone account for about 75% of the total area as well as production. The other states growing chillies commercially are Madhya Pradesh Punjab and Bihar. The highest yield is in Jammu & Kashmir Orissa Tamil Nadu Delhi West Bengal Punjab and Bihar.

Till recently about 90 95% of total exports of chillies (mostly of Sanam variety of Tamil Nadu) was to Sri Lanka alone but because of the recent total ban on the import of chillies into Sri Lanka India is exploring the possibility of diverting chilli exports to other sophisticated markets in the world. The possibilites of exports to the Middle East countries including the Gulf States remain to be explored on a priority basis. Development and export of paprika type peppers to European countries provide another opening for Indian chillies.

Uses and Nutritive Value

Different chilli varieties are grown for spices condiments vegetables sauces and pickles. Chillies used as spice are picked at full ripe stage and used after drying and grinding. Their sauces are made by pickling the pulp in strong brine or vinegar. Its extracts are used in the production of ginger beer and other beverages. Capsicum frutescens is used in medicine as carminatives internally besides being an external counter irritant. Green chillies are rich in vitamin A and C. The pungency is due to alkaloid Capsaicin ($C18 H27 NO3$). The red colour of fruits at the ripening stage is due to the presence of pigment Capsanthin . The green chillies contain rutin which has medicinal value and is of immense pharmaceutical needs. The seeds of chilli contain traces of starch. Bajaj reported the constituents (mean) of red chilli are as follows dry matter 22.02 per cent ascorbic acid 131.06 mg/100 g (Fresh weight) oleoresin 66.53 ASTA units colouring matter 67.38 ASTA units capsaicin 0.34 per cent (dry weight) crude fibre 26.75 percent and total ash 6.69 per cent.

Origin and History

Capsicum originated in the New World tropics and subtropics. It was introduced into Spain by Columbus in 1493. Its cultivation spread from Mediterranean region to England by 1548 and to Central Europe by the end of 16th century. Chilli is actually reported to be native of South America and its cultivation was known to the natives of Peru since prehistoric times. It was not known to Indians about 400 years ago as this crop was first introduced in India by Portuguese towards the end of 15th century. However cultivation became popular only in the 17th century.

Production and Distribution

The world trade in spices during 1995 96 was estimated to be 5.5 lakh tonnes worth US $1873 million and is projected to be 6.3 lakh tonnes worth US $2000 million by 2001 AD. India s production in 1994 95 is reported to be 24.89 lakh tonnes and export during 1995 96 was 2.02 lakh tonnes (i.e. 36.73% of global trade in volume) valued US $227.74 million (12.16% of global trade in value) which was only 8.1 per cent of total internal production.

India is one of the leading chilli producing countries of the world. The crop is grown practically all over India occupying 956500 hectares area with production of 945500 tonnes of dry chillies in 1996 97. Andhra Pradesh Maharashtra Karnataka and Tamil Nadu account for about 75 per cent of the total area as well as annual production of the country. The other states growing chillies commercially are Madhya Pradesh Punjab and Bihar. The highest productivity is in Jammu and Kashmir Tamil Nadu Delhi West Bengal Punjab and Bihar. In hills of India the area under chillies is quite meagre and mostly limited to the kitchen gardening only.

India is the largest exporter of chilli (23178 million tonnes) i.e. 23.82 per cent of total spice export is of chilli (1990 91) Hardly 2.5 3.0 per cent of country s production is being exported earning foreign exchange of about 5 10 crore rupees annually. India exports chillies and their products mostly to Abu Dhabi Australia Canada Japan UK and USA.

Nature of Plant

Capsicum frutescens L. commonly called chilli belong to family Solanaceae and having chromosome number 2n = 2x = 24. It is herbaceous or semi woody annual or perennial. The leaves are ovate tapering to a sharp point entire upto 15 cm length The flowers are small white and borne singly or in clusters of 2 or 3 in the axils of the leaves. The stamens are five which are alternating the petals. The fruits are of diverse shapes and sizes depending upon the variety.

Pollination

The extent of natural crossing in peppers is reported to be about 16.5 per cent. Flowers remain open for 2 3 days and the percentage of fruit setting is 40 50 per cent. The flowering begins 1 2 months after planting and it takes again one month for fruiting.

The flowers of chillies open in the morning between 6 10 AM and the anthers dehisce an hour after the flower opening. However flower opening and anther dehiscence to a large extent depend upon the weather conditions. During cold as well as cloudy days the opening of the flower is delayed. Crosses can be made at any time during the day but morning hours are preferred. Flowers are emasculated in bud stage and pollens are transferred to the stigma either from mature undehisced anther by scooping it out through the lateral sutures with the help of needle or by touching a freshly dehisced anther to the stigma with the forcep. Hands and tools (forcep needle scissor etc.) are washed with 95 per cent ethyl alcohol. Pollinated flowers are protected from bees by a double layer of cheese cloth loosely wrapped around the branch enclosing leaves and flowers and securely fastened. Properly marked plastic labels describing the cross (i.e. female x male parent) and date are attached. Pollinated flowers are periodically checked and the cheese cloth removed after 4 6 days of pollination. Fruits normally mature in about 45 days.

Production Technology

Soil

Chillies grow on a wide range of soils but for high yields light loam soils are the best. In sandy soils the crop can be grown with success provided adequate irrigation and fertilizers are available. Acidic and alkaline soils are not suitable for chilli cultivation but can tolerate slightly acidic soil. The optimum soil pH required by the crop is 6.5 7.0. The field is prepared with deep ploughing followed by 2 3 cross harrowings. For good

drainage field should be well levelled.

Climate

Chillies can be grown successfully in both warm and cold climatic conditions with altitude ranging from sea level to 2000 meters above. The ideal temperature range is 20 25°C. The crop is killed by freezing temperature and frost. Heavy and continuous rain during flowering and fruiting result in poor fruit set and dropping of flower buds. High temperature and dry winds are injurious to plants lead to flower drop and ultimately poor fruit set.

Sowing Time

In northern India two sowings are done i.e. June July for the autumn crop and November for the spring summer crop. In the East and South India the crop can be grown throughout the year. In the hills the seed is sown in March April. Under Himachal Pradesh Conditions February May June and November are the sowing times in Zone I (low hills) March May in Zone II (mid hills) and April May in zone III and IV (high hills).

Seed Rate

About 1 to 1.5 kg of seed sown in 0.01 ha will give sufficient seedlings to transplant in one hectare area under hill conditions of India depending upon the variety. The treatment of seed with Ceresan or Agrosan GN as a plant protection measure against seed borne diseases is desirable.

Transplanting

Chilli seedlings are transplanted when they are about 4 6 weeks old (10 15 cm tall) depending upon season. Double transplanting i.e. one extra transplanting in a second seedbed gives an earlier and higher yield. The usual spacing in northern hills of India is 45 cm from row to row as well as plant to plant. Experiments have shown that closer spacings within the rows as well as double transplanting of seedlings enhances higher and early yields. Just after transplanting light irrigation should be given in order to establish the plants.

Interculture and Weed Control

Soil around the root system should be kept loose by keeping down the weeds. Use of Alchlor 50 EC @ 2 litres per hectare as pre planting alongwith one hand weeding effectively control weeds. TOKE granules @ 5 kg per hectare is also found effective in weed control of chilli.

Manures and Fertilizers

Deficiency symptoms of various macronutrients in chillies as reported are given below

Nitrogen Stunted growth older leaves pale green start getting bleached from margins inwards until finally the entire leaf is bleached to pale white. The leaves eventually shed prematurely.

Phosphorus Leaves small and bluish green in the beginning and later turn to dirty greyish green. Older leaves turn brown and shed prematurely.

Potassium The leaves are normal green but smaller in size with crinkled surface. Small white necrotic spots appear over the entire lamina in the older leaves. Finally there is scorching of the margins followed by pre mature abscission of the leaves.

Chillies have a long growing season and therefore require a judicious use of manures and fertilizers. Good fertile soils well supplied with humus are most desirable for growing chillies. Heavy application of nitrogenous fertilizer may increase vegetative growth and delay maturity. Experiments conducted at Dr. Y.S. Parmar University of Horticulture and Forestry Solan (HP) have shown that N P K requirements of medium fertility soils are 75 75 55 kg per hectare respectively alongwith 10 tonnes of well rotten farmyard manure. Whole quantity of FYM phosphorus potash alongwith half nitrogen should be applied at the time of

field preparation for transplanting and the remaining half as top dressing in two equal splits at one month interval after transplanting.

Irrigation

The maintenance of uniform soil moisture is essential to prevent blossom and fruit drop. When there is insufficient rainfall the crop should be irrigated frequently. Generally in India 8 9 irrigations are given depending upon rainfall soil type humidity and prevailing temperature.

Harvesting

The stage of maturity at which chillies are picked depends on the type and purpose for which they are grown. Chillies used for drying are picked at full ripe stage for vegetable purpose at green but full grown and for pickle at either green or ripe stage. Generally the yield of fresh green chillies is 3 4 times higher than that of dry chillies. Under rain fed as well as irrigated conditions yield of dry chillies is 5 10 and 15 25 quintals per hectare respectively.

Drying of Chillies

Chillies are perishable having 70 80 percent moisture content but for safe storage the moisture should be 10 per cent. In India the ripe chillies are dried under sun for 10 15 days depending upon weather conditions. Excessive delay in drying results in growth of micro flora and subsequent loss of quality. Commercially it is dried at 54°C for 2 3 days.

Proper maintenance of parental lines is an integral part of hybrid seed production as uniformity of a hybrid depends entirely upon the homozygosity of parents. The use of selfing technique by inducing mechanical cleistogamy as suggested by Pamidi in chilli can be effectively used for maintenance of parental lines. In this method a drop of plant gum available in tubes is applied on the tip of unopened flower which results in selfing. Use of this technique can help not only in the maintenance of inbred lines but also in the selfing of vast segregating populations.

Breeding for Disease and Insect Pest Resistance

Anthracnose bacterial leaf spot and virus complex (TMV CMV PVX and PVY) are important diseases of chillies in India particularly in the hills. Resistant sources to these diseases have been reported and well documented in the literature. However results of practical significance are very limited. Only few varieties are released so far. Among these Punjab Lal (released by PAU Ludhiana) Pant C 1 (released by GBPUA&T Pantnagar) and Pusa Sada Bahar (released by IARI New Delhi) having multiple disease resistance have made impact in commercial cultivation of chillies.

Among insect pests aphids and thrips are important with respect to hills of India. Resistance to these insects has been documented in literature. However development and release of high yielding superior cultivars having resistance to these insect pests is yet to be done in India.

Mutation Breeding

Mutants like X rays gamma rays EMB NMH have been used in chilli for the induction of mutations. But so far only one variety i.e. MDU I has been released in 1977 by Agriculture College and Research Institute Madurai for commercial cultivation. This variety was developed by treating the seeds of variety K I by gamma rays. The variety has compact plant type higher yield and capsaicin content.

(ii) PAPRIKA (C. annum)

Importance

Spices are indispensable in the individual kitchen to food manufacturing and processing industries as it provides individuality to the food dishes with different receipes. Among the spices capsicums are the most colourful aromatic and important with different requirement around the world. It was so important even

Columbus had to take up his second expedition when he observed that natives of new world use a colourful red fruit called aji or axi with most of their foods in his first expedition. Paprika (now entered in the vocabulary of many nations) the Hungarian name for the fruits of Capsicum species is a derivative of the Greek Latin pepri piper. Kardos mentioned that paprika obtained its botanical name (Capsicum) from the Greek words Kapso Kaptein (bite) or Kapsakes (pod capsule). Rosengarten opined that Capsicum (red pepper) alongwith other spices were introduced to old world of Europe Asia and Africa from New World of central and South America. In India it was introduced by Portugese in the 17th century in and around Goa from where it spreaded to other parts of the country. Now it exists with a wide range of variation in size shape colour pungency and seed content. Cultivation of paprika in Hungary includes crop both as a vegetable and as a condiment which is further referred as vegetable paprika to green pepper used for raw consumption in making vegetable dishes processing into canned and pickled forms. Other is as Spice paprika (red pepper) cultivated for production of varieties suitable for making paprika powder and extracting oleoresin or other seasonings of the biologically matured red ripe fruits. But in the International trade paprika is a mild variety of genus Capsicum being one of the most important spice used as ground powder or paprika oleoresin (obtained by solvent extraction of the dried ripe fruits). Paprika Oleoresin is a homogenous dark red liquid and is dispersible in water and vegetable oils. It is used for seasoning the food and imparting red colour in vegetable and non vegetable preparations snacks sauces soups and pickles. One part of oleoresin can replace 50 60 parts of ground red paprika. Observing the potential of this crop with 30% annual growth for exporting oleoresin which was around 950 mt during 1991 92 could estimate 2000 mt in 1995 96. Paprika development for providing raw material to Oleoresin industries has also been taken up in India to meet the export potential of this crop and also to meet the home consumption. Paprika is marketed in ground or oleoresin form differing in grades of colour value and pungency. Some dried paprika fruits (in the form of strings) are marketed for using in special foods. Thus chillies and paprika the two dominant types of Capsicum are used all over the world as a spice crop.

Paprika belongs to Solanaceae family of genus Capsicum most of the paprika varieties fall under species annuum. The fruits vary from roughly cherry shape about the size of apricot grown in Spain and Morocco to long conical anaheim shaped cultivated in Hungary USA and Canada. The dried ground product is available in sweet to mildly pungent forms with a wide range of colouring content capsaithin.

Paprika or Hungarian Paprika also called sweet pepper or Spanish pimento is the mild or non pungent variety of chilli or capsicum. The dried ripe red paprikas are valued chiefly for their brilliant red colour and mild flavour. The European paprikas are different from their cousin red chillies which are grown extensively in India. Today there is considerable demand for paprika powder in the Western world. It is desirable to extend the area wilder paprika in India with the ultimate object of diversification of exports particularly when the gates of Sri Lanka are closed to all countries including India for the import of chillies into Sri Lanka. Besides the price of paprika in 1994 in New York was US$ 3.05/ kg more than double that of chillies which were priced at US$ 1.41 / kg. Hence there is good scope for growing and exporting paprika from India. Some success has already been attained both at the IARI New Delhi and CFTRI Mysore where several varieties of paprika have been successfully grown indicating good scope for expansion of area under paprika.

It is reported that it was during a Turkish invasion of Hungary in the 16th century that a new crop was introduced to the land of the Magyars. They called it Turkish pepper which in the Hungarian language became paprika. In reality paprika was not Turkish at al. It was a product of the New World member of the huge plant family of pod peppers called Capsicums native to the Western Hemisphere. Turkey had simply been one of the many places which received seeds of capsicum plants soon after the discovery of the Americas. Yet paprika as it developed in Europe became a very special spice which was quite different from its relatives across the Atlantic. In Europe under different soils and climates and due to crossbreeding

the fruit of these capsicums took on new characteristics. In Hungary the traditional peppers became much milder than their American cousins but they still retained a distinctive nip. But regardless of whether the European peppers had little or no bite they all eventually became known as paprika. Even the Spaniards who had originally named their product pimenton were forced to use the term paprika when they entered the export market such was the acceptance and popularity which the Hungarians had built for this spice.

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