

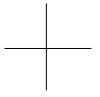
Chapter

12

PACKAGING ASPECTS OF SPICES & SPICE PRODUCTS

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PACKAGING ASPECTS OF SPICES & SPICE PRODUCTS

India is rightly called as “the home of spices” as it produces and exports almost all the spices except some leaf spices and herbs. Apart from major spices like pepper, ginger, turmeric, cardamom, cumin, celery seed, chilli, fenugreek and clove, many minor spices are grown in India. Totally about 52 kinds of different spices are grown. Blessed with appropriate soil and climate and a wide knowledge about the use of spices in foods, medicine, perfumes, etc., the country has the potential to develop into a quality market in spices. In terms of production, our country contributes 25-30% of the world production. During 2002-2003, India has exported spices to more than 100 countries and the exports are expected to go up further. Most of the trade is in bulk packages. Half the world’s production of oils and oleoresins of spices is produced in India for use in flavourings, meat processing, confectionery, liquor, perfumery and cosmetics.

In spite of this large production, much attention has not been paid on their primary processing and packaging aspects. The importing countries are particular about standards relating to safety and hygiene which may differ from country to country. But the regulatory authorities are always

more concerned about biological infestation, pesticide residues and the presence of toxins. Several consignments failed to reach the destination in good condition, one of the reasons being improper packaging. Hence, proper functional packaging can be expected to play an important role in maintaining quality of spices during storage and transportation.

In the subcontinent, whole spices are bought mostly in loose form. Packaged spices are being sold only in cities where incomes are higher and convenience of a product is a priority. Bulk packed whole spices which are being transported across the country in gunny bags, tend to lose the oil content but not pungency due to heat. The relatively high cost of spices and overwhelming importance of retaining their aromatic and special flavour components fully justify the requirement of a functional retail package even for the internal market.

Nature and Deteriorative Characteristics of Spices & Spice Products

‘Spices’ is the generic name for products derived from a variety of plant parts: bark, bud, flower, fruit, root, seed or secretion. FDA describes spices as “any aromatic vegetable

substance in the whole, broken or ground form that is used primarily to season food rather than to contribute nutrients". The main quality contributing factors like aroma, flavour and colour are sensitive to vagaries of climate and during storage. They are affected by factors like high temperature and humidity, oxygen, respiration and heating and insects, pests, microorganisms, rodents and birds which work in combination to cause the following deteriorations:

1. *Loss of aroma and flavour*

Loss of aroma and flavour is caused by the loss of volatile oil content due to evaporation, seepage and oozing out through packaging material and/or due to oxidation of some aroma components. This is accelerated by temperature.

2. *Bleaching of colour*

Bleaching of colour occurs in spices like green and bell pepper, green cardamom, turmeric, red chillies, paprika and saffron which contain natural pigments. This deterioration is caused by oxygen and accelerated by light, humidity and temperature and favoured by oxygen.

3. *Loss of free flowing nature*

The spice powders become soggy and lose their free flowing nature due to moisture ingress from the surroundings through the package. The extent of free flowing nature at different moisture contents (%) equilibrating to different relative humidities for five major spice powders are given in Table 12.1.

Caking and lumping problems do not arise in whole spices; however, development of musty odour does occur at higher RH.

4. *Microbial spoilage*

At and above 70% RH, microbial spoilage occurs in spices due to moisture sorption.

The relative humidities at which mould attacks different whole and ground spices at room temperature (25-28°C) are given in Table 12.2.

The microorganisms usually seen on raw spices, may not be harmful but give rise to problems when used in food preparation. So it is very important to check them.

5. *Insect infestation*

The problem of insect infestation in spices is quite serious. As many as 55 species of insects like drug store beetle, cigarette beetle, coffee bean weevil attack spices and spice powders. These insects require congenial atmosphere for their life. The tropical climate is very conducive for their activity and results in qualitative and quantitative losses. If warehouses are not ensured of adequate protection against rodents, they also cause a great deal of spoilage.

Packaging Material Requirement for Spices and Spice Products

To prevent or slow down the above mentioned deteriorative changes during storage, for easy handling, transportation and to have export potential for spices, the package:

1. Should have the ability to protect the contents from spoilage and spillage.
2. Should offer protection against physico-chemical and microbiological spoilage due to environmental conditions like humidity, temperature, light and oxygen. This requires a low water vapour and oxygen transmission rates and light transmissivity.
3. Should be a good aroma barrier to prevent loss of flavour substance from the product and pick up of foreign odours.

Table 12.1. Moisture-humidity relationship of different spice powders at 27°C

% RH	Pepper Powder		Turmeric Powder		Coriander Powder		Chilli Powder		Cumin Powder		
	EMC	Remarks	EMC	Remarks	EMC	Remarks	EMC	Remarks	EMC	Remarks	
11	2.5	FF	4.8	FF	4.7	FF	4.8	FF	-		
22	4.1	FF	6.4	FF	5.7	FF	5.5	FF	3.7	FF	
32	5.7	FF	8.0	FF	6.4	FF	6.6	FF	4.6	FF	
44	7.2	FF	9.5	FF	7.2	FF	7.6	FF	6.7	FF	
56	9.2	FF	11.0	FF	9.6	FF	10.8	SS	8.3	FF	
64	10.2	FF	12.1	SS	11.2	SS	12.9	SL	9.7	FF	
75	13.2	SS	15.7	SL	13.3	Mould	17.5	Mould	14.7	SL	
86	14.2	Mould	21.1	Mould	19.3	Mould	28.1	Mould	21.2	Mould	
92	21.4	Mould	33.7	Mould	23.4	Mould	-	-	39.9	Mould	
CMC	10.5		12.2		11.5		13.2		10.0		
CRH	65		65		65		65		65		
RH =	Relative Humidity		CRH =		Critical Relative Humidity		SL =		Soggy and lumpy		
EMC =	Equilibrium Moisture Content		FF =		Free flowing		SS =		Slightly soggy		
CMC =	Critical Moisture Content										

Source: Reports of R&D projects at CFTRI.

Table 12.2. Initial moisture, equilibrium relative humidity, critical moisture and critical relative humidity at which mould attacks whole and ground spices at room temperature (25°C - 28°C)

Spice	Initial moisture (%)	Equilibrium relative humidity (%)	Mould growth at moisture level (%)	Mould growth at relative humidity (%)
Cardamom, greater (brown) (amomum)	7.79	45	14.16 - 22.19	73 and above
Cardamom (green)	10.46	40	16.90 - 22.78	73 and above
Black pepper (whole)	8.19	28	17.74 - 23.34	73 and above
Black pepper (powder)	6.48	29	13.92 - 16.82	73 and above
White pepper (whole)	5.09	20	14.47 - 17.10	81 and above
White pepper (powder)	6.64	18	15.11 - 18.79	81 and above
Red chilli (whole)	4.63	10	16.50 - 24.67	81 and above
Red chilli (powder)	7.48	8	21.28 - 28.10	81 and above
Ginger (powder)	7.50	20	13.80 - 20.00	71 and above
Ginger powder (sweetened)	6.50	11	11.00 & above	73 and above
Curry powder	6.71	28	16.43 - 22.41	81 and above
Mace (whole)	4.33	43	9.74 - 13.34	81 and above
Fennel seed (whole)	8.16	50	24.33	91 and above
Aniseed (whole)	8.00	62	21.11	91 and above
Celery seed (whole)	8.96	53	25.09	91 and above
Fenugreek seed (whole)	7.73	4	23.59	91 and above
Coriander seed (whole)	6.68	13	13.57 - 19.19	81 and above
Coriander (powder)	7.18	22	21.81	91 and above
Cinnamon (whole)	3.24	4	16.67	91 and above
Clove (whole)	6.42	30	22.19	91 and above
Garlic (powder)	6.00	13	No mould	No mould
Garlic salt	2.46	5	No mould	No mould
Mustard flour (Coleman)	6.48	6	15.90 - 23.30	81 and above
Turmeric powder	8.00	22	12.43	91 and above
Onion powder	4.00	5	62.46	90 and above

Source: Reports of R&D projects at CFTRI.

4. Should have good oil and fat resistance characteristics.
5. Should have good machineability characteristics and possess the required mechanical strength properties.
6. Should have good resistance to insects and mites.
7. Should be compatible with the product packed as regards tainting and migration and conform to the food laws of importing and exporting countries.
8. Should have good appearance and printability to assist in selling by suitable attractive graphics.

In addition, it should be economical, easily available and disposable.

PACKAGING METHODS & MATERIALS FOR SPICES AND SPICE PRODUCTS

BULK PACKAGING

Whole Spice

Each spice is unique in its quality changes during storage. Some are valued for flavour, some for colour, some for pungency and all are valued for size and appearance. They vary a lot in their bulk densities which relates to the size and volume of the packages. But in most of the whole spices, flavour moiety is well protected by the cells from evaporation and oxidation. Hence, there will be negligible or no loss of flavour during storage. Natural wax coatings on them prevents moisture transfer or oxidation. So, packaging problem here reduces to just bulking for storage, transportation, and to protect from insect infestation and moisture ingress at high humid region. Traditionally, jute bags are

used for storage of spices in warehouses. A twill, B twill or DW gunny bags are used depending upon the value of the spice. The weave clearance of 1-2%, 3-5% and 4-6%, prevent spoilage and restrict movement of insects into the gunny bags. Sometimes, double jute bags are also used for better protection. Multiwall paper sacks or cotton bags are also being used. In these traditional packages, maximum loss of volatile oils up to 23% over a year in whole spices has been observed. But these have the problem of moisture ingress and sifting. In such cases, polyethylene lined jute bags or HDPE/PP woven sacks are recommended. For cardamom capsules, wooden and metal containers lined with moisture barrier materials are being used. Green cardamom with a moisture content of below 10% will keep well during transportation and storage if packed in 75 μm black coloured polyethylene lined packages in wooden chest. In case of dry whole chillies, due to low bulk density, volume poses a problem. Hence compressed packs have been developed. For chilli with a moisture content of 10% and by applying a pressure of 2.5 kg/cm² using appropriate baling process, it is found to reduce the volume by 78% of its original volume without causing any damage to the product. Bulk compressed packages weighing 10 and 25 kg are packed in 75 μm polyethylene bags. Below 8% moisture level, chillies should not be compressed as they are brittle and breakage may occur by compression.

Spice Powders

The use of whole spices in food processing is limited as they do not lend their full characteristic flavour, colour or pungency but only provide pleasing appearance. The spices are ground to release the flavour. Finer

the powder, more flavour is readily available. So, powdered spices, masala mixes (mixture of different ground spices), and curry powders are available. Due to the grinding, as the cell membrane and the natural protection ruptures, and due to tiny particle size, the surface area available for reaction increases. Hence, the rate of deterioration of ground spice is much higher than that of whole spices. To avoid spillage, they are packed and stored in multiwall paper bags, lined textile sacks, lined HDPE/PP woven sacks, glass/metal containers.

UNIT PACKAGES

Whole Spices

The importing countries insist more on bulk packages and the packaging requirements of whole dried spices are not very stringent. Unit packages are coming into use gradually in the country. Most people buy whole spices in loose. Packaged spices are mostly sold only in cities where super bazars are established. Whole spices are packed in 50 g to 1 kg units in 50–70 μm polyolefin pouches. Few brands are packed in PET/PE laminate for good printability. Considerable amount of green and red pepper is exported in A 2½, A1 tall or 5 oz baby tin containers in 2% brine solution or as pickles and they are also packed in glass containers. Dehydrated green and red pepper with a moisture content of 3–4% (ERH 20–30%), which are very sensitive to oxidative changes like bleaching of colour especially in presence of light, needs good protection against moisture, oxygen and light. They can be stored only for short term in polyolefin pouches and need metallized PET/PE or Al foil laminate for longer storage periods as consumer unit packs. HDPE containers for asafoetida, glass bottles for cardamom and for few herbal spices are also available.



Fig. 12.1. Functional packages for whole spices

Spice Powders

Powdering of spices hastens their deterioration unless protected well by a package. In a small unit pack, all the more care is needed to offer long shelf life. The relatively high cost of ground spices and the overwhelming importance of retaining their aromatic and special flavour components, justify the selection of expensive glass or metal containers. Among plastics, PET containers and PET-G co-polymer containers meet the requirements and are good replacement for metal and glass at places where RH is below 70%. HDPE/PP jars do not provide the required shelf life with respect to flavour retention. Many flexible films and laminates were tested at CFTRI for their suitability as unit packs of ground spices. Major spice powders of pepper, turmeric, cumin, coriander and chilli were studied using different packaging materials.

Approximate periods of shelf life for different spice powders packed in various consumer packs and stored under two storage conditions, namely, 92% RH, 38°C (accelerated) and 65% RH, 27°C (IS condition) are presented in Tables 12.3 and 12.4.

Packaging material	Pepper		Turmeric***		Cumin		Coriander		Chilli	
	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.
Initial moisture content (% by w.t.)	9.5		9.5		6.0		6.0		6.0	
Critical moisture content (% by wt.) w.r.t. caking & lumping	11-12		11-12		9-10		10-11		10-11	
50 µm LDPE	30	80	25	35	70	75	80			-
75 µm LDPE	50	75	45	30	-	-	-			60
50 µm HDPE	60	75	-	-	-	-	-			70
50 µm PP	40	50	35	30	70	50	-			-
85 µm PP	60	60	50	20	-	-	-			-
75 µm MXXT Cellophane	25	10	35	5	-	-	-			-
Double Pouch of glassine gusset inside + 62 µm LDPE	35	50	45	20	-	-	80			-
Double pouch of 75 µm MSA Tcellophane inside + 62 µm LDPE	40	10	45	15	80	10	80			-
Glassine / 37 µm PE laminate	-	-	20	5	-	-	-			-
Saran coated cello/PE laminate	-	-	40	5	-	-	75			50
Metallised polyester 12 µm / 37 µm LDPE laminate***	120	20	120	10	120-150	30	150-180			150-180
Paper/0.009 mm Al foil / 37 µm PE	expected 1 yr	20% @ 180 days	expected 1 yr	5% @ 180 days	expected 1 yr	-	expected 1 yr	expected 1 yr	expected 1 yr	expected 1 yr

* Shelf-life with respect to caking, lumping; ** % loss of volatile oil at the end of shelf-life period;
 *** Delamination will occur in turmeric and chilli if bond strength is not satisfactory.
 Source: Reports of R&D projects at CFTRI.

Table 12.4. Probable shelf-life of ground spices in different flexible pouches in 100 g consumer packs at 65% RH and 27°C (Normal storage condition)												
Sl. No.	Packaging material	Pepper		Turmeric***		Cumin		Coriander		Chilli		Remarks on packaging material
		SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	SL*	% Loss** of V.O.	
Maximum moisture content (% by wt. of the product in an atmosphere at 65% RH & 27°C)												
		10.0	11.0	9.0	11.0	9.0	11.0	11.0	11.0	-	-	
1	50 µm LDPE	60	80	30	50	60	75	80	90	90	90	1, 2, 3, 4 & 5: good moisture barriers but poor volatile barriers; 6: fairly moisture proof, good v.o. barrier.
2	85 µm LDPE	60	75	30	50	60	-	60	90	90	90	7: moisture proof, fair barrier to v.o.
3	50 µm HDPE	90	75	60	-	90	-	90	120	120	120	8: good barrier to both moisture and v.o.
4	50 µm PP	90	65	60-90	40	90	45	120	150	150	150	9, 10: fairly moisture proof, good barrier to v.o.
5	85 µm PP	120	50	120	15	120	-	150	-	-	-	11: good moisture proof, good barrier to v.o.
6	75 µm MXXT Cellophane	200	10	200	10	200	-	200	200	200	200	12: very good moisture proof & barrier to v.o.
7	Double Pouch of glassine gusset inside + 62 µm LDPE	120	50	120	15	120	-	150	-	-	-	
8	Double pouch 75 µm MSATcellophane inside + 62 µm LDPE	200	10	200	10	200	20	200	200	200	200	
9	Glassine / 37 µm PE laminate	120	-	120	15	200	-	200	200	200	200	
10	Saran coated cello/PE laminate	200	-	200	10	-	-	-	-	-	-	
11	Metallised polyester 12 µm / 37 µm PE laminate***	1 yr	10-20	1 yr	20-30	1 yr	10	1 yr	1 yr	1 yr	1 yr	
12	Paper/0.009 mm Al foil / 37 µm PE	1 yr	5	1 yr	10	1 yr	-	1 yr	1 yr	1 yr	1 yr	

* Shelf-life with respect to caking, lumping; ** % loss of volatile oil at the end of shelf-life period;

*** Delamination will occur in turmeric and chilli if bond strength is not satisfactory.

Source: Reports of R&D projects at CFTRI.

The shelf life reported in Table 12.3 is based on ingress of moisture leading to predominantly unacceptable change such as lumping or caking. Also presented in Tables 12.3 and 12.4 are losses of volatile oil in percentage at the end of shelf life period or at a particular storage period.

For internal market, spice powders sometimes are being packed in polyolefin pouches. Whatever may be their thickness, they are inadequate to prevent loss of volatile oil. Due to oozing out of volatile oil, smudging and disfiguring of print occur especially in pepper and turmeric where volatile oil content is higher. Metallized polyester/PE and paper/Al foil/PE laminate pouches, which are very good barriers to moisture and volatile oil, offer adequate protection for more than a year for different ground spices under Indian conditions. Neither the loss of volatile oil nor the moisture ingress in these pouches are considerable even after long term storage under both the storage conditions. However, in metallized polyester/poly laminate pouches containing turmeric and pepper powder which are rich in volatile oils, delamination of the laminate was observed. To overcome this problem, a three ply laminate consisting of 12 μm PET/Print/12 μm Met. PET/PE need to be used. This also prevents smudging and disfiguring of print. Even the laminates used for packing pepper

and turmeric should have a good bond strength to avoid delamination and disfiguring of print. Metallised laminates are not suitable for chilli powder as the metal gets dissolved. Presence of polyester or foil offers better resistance to insects than polyolefins and cellophanes, and hence are better suited for long term storage. An outer duplex board carton affords further physical strength and good printing surface. These laminate pouches are well suited especially for export markets which need over one year shelf life.

Packaging of Dry Spice Mixes and Pastes

Spice powders and masala mixes are the mixtures of different powdered spices in various combinations. The packaging pattern for dry spice mixes is almost the same as that of powdered spices. Some masala mixes contain ingredients like common salt, black salt, roasted gram powder, etc., other than spice powders. This changes packaging profile to some extent. The addition of salt increases the hygroscopic nature of the product beyond 70% RH. The products that contain black salt give sulphury odour and show tendency to corrode the can or aluminium foil web (used for pilfer-proofness in bottles) if the moisture content goes beyond 9%. The critical moisture content for masala mixes ranges between 8–10%, which is about 2% less than that of powdered spices. Since these are all value added products mainly for export, economics of package will not be the main criterion. Hence, glass jars, tin containers, PET or PET-G Jars, Al foil or PET/met. PET/PE laminates are the choice materials and can offer 9 to 12 months shelf life under normal storage conditions. Different masala pastes are also coming up in the market. Blister packs for short shelf life

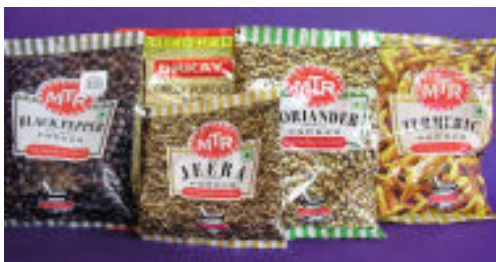


Fig.12.2. Attractive packages for spice powders

for internal market and glass/PET jars for export market are being used for the packaging of these pastes.



Fig. 12.3. Unit packs for dry spice mixes

No package can improve the quality of any product packed in it. For longer shelf life, the spice powders should have minimum moisture and maximum volatile oil in them. Loss of aromatic flavour due to heat is the limiting factor than light and oxidation leading to flavour deterioration of spices. Hence, cryogenic grinding of spices adds more to their shelf life than any other factor. Nitrogen/ vacuum packaging does not give much beneficial effect for longer shelf life. Micro-encapsulation of flavours provides protection for many spice powders and mixes. Encapsulation is a technique where particles of a core material consisting of selected components are coated with continuous film of a polymer or uniformly distributed in a solid matrix by occlusion and/or adsorption. If the particle size is less than 5,000 μm , then it is classified as micro-encapsulation. It serves to provide protection for many flavour compounds which are sensitive to light and oxidation. An edible, non-toxic, inert material is used as a wall material. The encapsulation protects the flavour moiety like a natural cell. Hence, the packaging requirement of encapsulated spice powder will be similar to that of whole

spices. While cooking, due to dissolution of the wall, spice powder gives its full pep to the food.

Packaging of Sauces/Liquid Salad Dressings and Fat Spreads

Sauces are the first foods to be packed in plastic bottles. They were being repacked in squeeze bottle for convenience after initial purchasing in metal cans or glass bottles. Even though retail packs in PE bottles are in use, slight deterioration occurs with very strong flavours. However, co-extruded LD/Tie/EVOH/Tie/PE blow moulded bottle was found to offer good shelf life. PET/EVOH, PET/EVOH/PET constructions, although little expensive, are being used for ketchup. For salad dressing which contains oil, vinegar and other ingredients along with spices, PET bottles are preferred to EVOH constructions or PP/HDPE containers. Smaller size pouches (single use) are also popular for salad dressings. As these pouches have considerable surface to volume ratio, a high barrier material like foil laminate, sealant layer being EAA or



Fig. 12.4. Unit packs for masala pastes, sauces, salad dresses, etc.

ionomer to avoid leakages are in use. Thermoformed containers made of OPP or HIPS are being used for cheese spreads, jam dips, etc., which are being sold in refrigerated section in retail store.

Packaging of Oleoresins and Volatile Oils

The active principles like odour, pungency and colour removed from dry herbs and spices are known as oleoresins. They have good export demand. Being highly volatile, they have to be packed in tightly closed glass bottles, suitably lined tin or aluminum containers. These need to be protected from light, heat and oxygen. Hence they need to be stored in cool, dark place. Of late, oleoresins are also packed in thick food grade HDPE containers. Aluminum container with suitable inner coatings can also be considered as consumer pack for oleoresins as it helps in easy dispensing.

Insect Infestation and Microbial Contamination in Spices

Important problem in spice packaging relates to insect infestation and microbial contamination during storage and distribution. The extent of damage depends on factors like initial contamination of the product, the type of insect and/or microbe and the packaging material used. Insect infestation may occur or develop in spice during any of the post-harvest operations such as harvesting, drying, threshing, transportation or storage. Jute bags, which are commonly used for storage, many times carry insects or their stages. In godowns also, insects may harbor in cracks and crevices, roof rafters, windows, dunnage and packaging materials. Hence, a variety of packaging materials are being used for packaging of spices to prevent insect

penetration. The product must be free from any insect or its stages before packaging. The initial microbial load and insect contamination can be reduced to a great extent by adopting some methods like heating, sterilization, microwave treatment, fumigation and γ -irradiation. But since first three methods cause loss of volatile oil, other two methods are followed for spices. Usually, spice products are fumigated either using liquid fumigants like methyl bromide at a concentration of 32 g/m³ with an exposure time of 24 to 48 hours or using commercially available solid fumigant aluminum phosphide at concentration of 3 to 6 g/m³ as liberated phosphine with an exposure time of seven days. As soon as the products are fumigated, they can be packed in any of the above flexibles, used for packaging of spice powders and most of these transmit out any residual fumigant vapor present in the packaged product. Except for metallized polyester/PE and foil laminate, the product can be fumigated even after packing and sealing the packages.

γ -irradiation is effective for commercial decontamination of spices. A dose of 3-10 kGy can reduce the viable cell count to an acceptable level and does not affect the sensory quality of spices. The limitation of irradiation of spices is the high capital cost of irradiator. Irradiation is a curative treatment only and products are prone to reinfestation once the packet gets damaged. If the products need to be stored at relative humidities above 70%, to prevent mould growth, the moisture content of the product at the time of packing should be minimum (8 - 10%).

Quality Control of Spices

International Organization for Standardization (ISO) and Codex Alimentarius

Commission are working at international level for controlling the quality of spices. ISO defines the product quality for each and every spice. Unless ISO is satisfied that the product conforms to certain specifications compatible to those required on the international market, it will be difficult to compete. It has already prepared 64 standards and almost all important spices have been covered and standards are reviewed once in 5 years to be constantly updated as more information and new technologies crop up. There are plans for the formation of international spice community (ISC) in near future with major importing countries as member countries to the ISC. This helps the producing countries in channeling their production to the needs of the importing countries.

As most of the spices and spice products are exported, the quality requirements of the importing countries have to be followed. This means our spice industry and trade have to invest in conscious efforts in different stages of quality control so that the Indian spices and spice products would meet the stringent requirements of importing countries and thus gain better acceptance. Among the quality standards, absence of pathogens, added colours, flavours, antioxidants, tolerances for pesticide residues, insect filth and mould, mammalian excreta and foreign matter, etc. are cited as requirements to be controlled during harvest and processing. As per the packaging and labeling act of USA, it is mandatory in the case of spices packed in retail/consumer packs that the product is free from the above matter. Quality parameters like volatile oil content and moisture content can be controlled using a suitable package. By keeping moisture content below 10%, mould and insect development can also be controlled.

For the internal market, we have PFA Act 1954, which is mandatory. Legislation protects the common consumer against the supply of adulterated foods. In 1991, regulations on the application of irradiation on foods have been brought out as a special act. Other regulations that are applicable to spices and spice products include those of Bureau of Indian Standards (BIS) for standardization mainly of processed foods and Agricultural Produce Grading and Marketing Act (AGMARK) for standardization of raw agricultural products.

The relevant Indian standards specify a moisture content of maximum 10 to 12% for different spices and spice powders and the product should be free from added colour, oil, flavour, preservatives, mould growth, fungal contamination, insect infestation and extraneous matter. Further, the spices should have their characteristic colour and flavour and should be free from musty and rancid odours. For packaging of these products, jute, cloth and paper cartons with 75 μm polyethylene liners, tin or glass containers, aluminum foil laminates and cellophane bags are mentioned. In view of the functional properties of polyester and nylon based laminates and co-extruded films, they can also be included for the unit packaging of spices. Lined HDPE/PP woven sacks for bulk packaging of whole spices offer maximum protection. The packaging material should be of food grade.

Future Trends

Although considerable progress has been made in the country in the field of spice packaging, spices are still packed in traditional way which are either not functional or costly. India has to capture the market of exporting spices in consumer packages. Therefore, there is a need to shift

to the economical and functional packaging material for spices. Co-extruded films with nylon or EVOH as barrier layer and EAA or ionomer films with good hot-tack as sealant layer can be tried for spices owing to their excellent bond strength and barrier properties. Coated BOPP films, silicon/aluminium oxide/ PVDC coated films can be tried as their good clarity would allow excellent product presentation. Stand up pouches and lined folding cartons with foil laminates as liners can be an alternate to tin containers. PET or PET-G jars with dispensing neck, large enough for a spoon, can be very convenient. Multilayer jars with a flavour barrier EVOH layer can be considered for masala pastes and spice powders. Portion packs for pickles and seasonings can go in blister packs. Spicy sauces can go in PP cups with foil/HDPE laminate as top seal.

For bulk packaging of spices, using HDPE/PP woven sacks will help in minimizing spoilage/spillage during storage and transportation. CFB boxes with suitable liner bags will be convenient for storage and transportation. In-package fumigation methods need to be developed in the light of spice safety and make flexible insect proof by suitable methods. Evaluation of safety of different plastics in relation to toxicity, tainting and compatibility need to be worked out in view of probable migration of chemical additives from plastics into fatty and essential oil components packed in them. With increasing emphasis on recycling and environment friendly packages, packaging materials need to gear up to meet these challenges. Usage of biodegradable and recyclable materials in spice packaging would gain importance. An integrated approach should be developed to encompass unit and bulk packages considering the

product quality, maintenance, requirements like suitability, compatibility, insect and rodent resistant properties, etc to meet the inland and export potential.

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