

PACKAGING OF SPICES

Spices constitute an important group of agricultural commodities, which are considered indispensable for culinary purposes and for flavouring food. Some of the spices and spice products are also used for medicinal, perfumery and cosmetic purposes.



Branded Consumer Packs of Ground Spices



Packages of Spices

India is known as the “Home of Spices” and produces a large variety and quantity of spices. About sixty-three varieties of spices are grown in the country, which includes Pepper (King of Spices), Cardamom (Queen of Spices), Chillies, ginger, turmeric, coriander, cumin and many others.

As most spices grow under specific climatic conditions, annual production level and India’s share of spices in the world market has varied considerably in the recent years.

Although India exports spices to 130 countries in the world, of the total spices produced in the country, (with the exception of pepper) only a small quantity of about 6-7% is exported. The rest is consumed in the Indian market, as there is an immense domestic demand. A steady increase is observed in the export of value added spices. There is also a good scope to increase export earnings from spice oils and oleoresins as the global industry is increasingly leaning towards natural flavours.

The export performance of spices and spice oils for the last two years is shown in Table 1.

Product Profile

Spices are aromatic substances of vegetable origin and are derived from various parts of plants like leaves, bark, fruit, flower buds, stems, roots, seeds etc. Spices are used as condiments and seasonings and form an essential part of food preparations as they add flavour, taste and colour. Spices have good anti-oxidant and preservative properties as well as good anti-microbial and antibiotic properties and therefore, are also used for medicinal purposes.

TABLE 1
Estimated Export of Spices from India During April '02 to March '03
as Compared with April '01 to March '02.

Item	April' 02 – March' 03 *			April' 01 – March' 02		
	Qty ('000 Tonnes)	Value (Rs. Million)	Unit Value (Rs./kg)	Qty ('000 Tonnes)	Value (Rs. Million)	Unit Value (Rs./kg)
Pepper	20.00	1661	83.05	24.00	2119	88.30
Cardamom(s)	0.55	376	683.68	0.90	559	620.69
Cardamom(l)	1.30	185	142.15	1.25	204	163.04
Chilli	83.00	3015	36.33	75.00	2558	34.11
Ginger	8.50	241	28.34	8.00	250	31.29
Turmeric	32.00	994	31.05	35.00	846	24.18
Coriander	15.50	478	30.87	15.00	450	30.03
Cumin	10.00	762	76.15	14.00	1233	88.10
Celery	4.25	135	31.66	4.500	136	30.16
Fennel	4.20	167	39.68	4.00	163	40.70
Fenugreek	11.25	250	22.22	6.00	151	25.17
Other Seeds (1)	12.25	292	23.87	5.00	177	35.34
Garlic	1.25	57	45.64	1.10	39	35.19
Nutmeg & Mace	1.40	264	188.21	1.35	199	147.42
Other Spices (2)	26.00	1332	51.21	35.65	1623	45.53
Curry Powder	6.75	464	68.73	6.25	405	64.77
Mint Oil	8.50	3606	424.19	3.60	1276	354.56
Spice Oleoresins and other Oils	4.25	3623	852.44	4.40	3865	878.36
Total	250.95	17900		245.00	16254	
Value in Million US \$		370.10			341.60	

[Source: Estimate Based on DGCI & S Data, Shipping Bills / DLE from customs and last year's Export Trend.]

(*) Includes Menthol Crystal under Mint Oil.

(1) Includes Mustard, Aniseed, Bishops Weed (Ajwanseed), Dill Seed, Poppy Seed etc.

(2) Includes Vanilla, Tamarind, Asafoetida, Cassia, Saffron, Curry Leaf, Cambodge etc.

Spoilage Factors

In order to select a suitable packaging material/type of package for spices, it is essential to know the factors which affect the quality of spices.

Moisture Content

Spices, specifically spices in powder form, are hygroscopic in nature and pick-up moisture from the atmosphere resulting in sogginess and caking/lumping of the powder. Pick-up of moisture also results in loss of free-flowing nature of the spice powder.

Loss of Aroma / Flavour

Spices contain volatile oils, which impart the characteristic aroma/flavour to the product. Loss in the volatile oil content or oxidation of some aromatic compounds result in aroma and flavour loss.

Discolouration

Some of the spices like green cardamom, red chillies, turmeric, saffron contain natural pigments. Light can affect the pigments resulting in loss or fading of colour and deterioration.

Insect Infestation

Spices are prone to spoilage due to insect infestation, which can be further accelerated due to high humidity, heat and oxygen.

Microbial Contamination

In high humidity condition of 65% and above, moisture absorption occurs. Beyond a certain level of moisture content, spoilage due to microbial growth sets in.

Packaging Requirements

In order to maintain the quality of the spices during handling, transportation, storage and distribution, the packaging material to be used is to be selected with care, keeping in mind the functional as well as the marketing requirements. The packaging requirements for spices, in general, are listed below:

- To protect the product from spillage and spoilage.
- To provide protection against atmospheric factors such as light, heat, humidity and oxygen. The selected packaging materials should have high water vapour and oxygen barriers.
- The packaging material should have a high barrier property to prevent aroma/flavour losses and ingress of external odour.
- The volatile oil present in the spice product has a tendency to react with the inner/contact layer of the packaging material, at times leading to a greasy and messy package with smudging of the printed matter. The packaging material should therefore be grease and oil resistant and compatible with the product.
- Besides the above functional requirements, the packaging material should

have good machinability, printability and it should be easily available and disposable.

Forms of Spices

In India spices are distributed and traded in a number of forms such as:

- Whole spices (cardamom, black pepper, clove, turmeric, ginger, cinnamon, cassia)
- Seed spices (celery, fennel, cumin, fenugreek)
- Powdered or ground spices (turmeric, chillies, ginger)
- Spice mixes (curry powders and masalas)
- Paste (curry paste, vindaloo paste, ginger-garlic paste)
- Concentrates (tamarind concentrate)
- Oils and oleoresins

Whole spices are generally traded in bulk quantities and the processor grinds them and blends them for the finished spice product. Some quantity of the ground and blended spices are packed in consumer packs of capacities ranging from 100 grams to 1kilogram. The protection required by whole spices is from moisture ingress / pick-up and insect infestation. The loss in flavour during storage in whole spices is negligible as the volatile oils are well protected within the cells of the plant material. Powdered spices are also traded in bulk quantities and only a small portion is packed in value added consumer packs. In powdered spices, the deterioration is very rapid and much more care is required in selecting a suitable package.

Conventionally spices were exported in bulk packages, however with efforts of Spices Board and the Government of India, exports in branded and value added consumer packages is gradually on the increase.

Packaging Materials / Systems for Spices

Bulk Packaging

The traditional method is to use gunny/jute bags for packaging of whole spices, with capacities ranging from 10kg to 70kg. **The jute bags may be provided with a loose liner bag of polyethylene or may be without a liner. At times double gunny bags are also used, especially for whole black pepper. The double gunny bag is provided with an inner polyethylene liner.** The quality of the jute fabric used with respect to the grammage and the weave (ends/picks) varies from one trader to the other. There is no standardisation on the type and quality of the fabric used. A variety of jute fabrics such as hessian, light weight DW, A-twill, heavy Cee etc. are used.

Recently, some of the spice traders/packers use alternate bulk packaging media such as woven plastic bags which may be laminated or provided with a loose liner bag and multiwall paper sacks with a plastic liner bag. **The plastic based alternate packaging materials are used to overcome the contamination problems associated with jute. Moreover, the plastic bags / liners also help in retaining the quality of the spices packed inside for a longer time.**

The latest trend is to use Jumbo bags (Flexible Intermediate Bulk Containers) (FIBCs) for export of spices. These bags have a capacity of up to 1 tonne and offer various advantages such as:

- Bags are flexible, collapsible and durable
- Can be used for packaging of granules, powder, flakes and any free flowing material
- Product wastage / spillage and tampering can be avoided
- Since the handling is mechanised, less labour is required
- Saving in time for loading and unloading
- Bags are light in weight and, therefore, freight costs are reduced
- Creates eco-friendly, pollution free working atmosphere

The jumbo bags are sometimes made from cloth but mainly from plastic fabric, which can be laminated or provided with an inner plastic liner bag. The bags are provided with filling and discharge spouts and slings for hanging during loading/unloading operations. For designing a jumbo bag, factors such as capacity, product protection requirement, bulk density of the product, filling and discharge facilities available at the user's end, are to be considered.

Institutional Packages

The spice traders also use institutional packs of capacities ranging from 2kg to 10kg. The variety of packages used include laminated flexible pouches and plastic woven sacks which replace traditional material like tinplate containers and jute bags.

Consumer Packages

The options available to the traders/exporters of spices in the selection of a consumer pack for domestic and export market are quite wide. However, the selection/choice of the packaging material/system depends upon a number of factors, which are broadly listed below:

- Shelf-life period i.e. the degree of protection required by the product against moisture pick-up, aroma retention, discolouration etc. (this is more critical in case of powdered spices)
- Climatic conditions during storage, transportation and distribution
- Type/sector of market
- Consumer preferences
- Printability and aesthetic appeal

The package types generally used as consumer packs are:

- Glass bottles of various sizes and shapes with labels and provided with metal or plastic caps.



Unbranded Consumer Packs of Ground Spices

The plastic caps have added inbuilt features of tamper evidence, dispensing, grinding etc.

- Printed tinplate container with/without dispensing systems
- Composite containers with dispensers
- Plastic containers with plugs and caps with dispensing and tamper evidence features
- Printed flexible pouches – pillow pouch, gusseted pouch, stand-up pouch.
- Lined cartons



Composite Containers

The printed flexible pouches have recently become very popular due to their easy availability, excellent printability, light weight, machinability and cost-effectiveness. Also, depending upon the functional and marketing requirements, the laminate/film can be tailor made to serve a specific need.

The printed flexible pouches are generally laminates of various compositions. Some of the commonly used laminates are:

- Polyester/metallised polyester/LDPE
- BOPP/LDPE
- BOPP/metallised polyester/LDPE
- Polyester/Al foil/LDPE

Polyester and BOPP based laminates are generally more popular for spice packaging due to certain advantageous characteristics of each of these two films.

Polyester used for lamination is generally 10 or 12 μ thick. The film is highly transparent with excellent clarity, gloss and printability thus enhancing the sales appeal. The film has very low moisture and gas permeability and, therefore, ensures prolonged shelf-life of the contents with aroma, flavour and taste retention. The very high mechanical strength (tear, puncture, burst and flex) minimises damage to the contents during handling and transportation. The film has good machinability as well as printability. The latest printing technologies help in improving sales promotions. The film is free from additives and, therefore, does not impart any odour or taint to the sensitive spice product that is packed.



Plastic Pouches for Whole Spices & Powders

BOPP films may be heat sealable or non heat sealable. The film has high yields, is stable under climatic changes and has excellent moisture barrier. This film is smooth, glossy, crystal clear and has high mechanical strength and non-contamination property for food contact applications.



Spices Packed in Pouch-in-Carton

The sealant layer of LD – HD or LDPE can be replaced by LLDPE or cast PP. Co-extruded films can also be used. PVDC, EVOH and EVAL based flexible materials also need to be studied as they are now in the market and these materials have high barrier properties.

A very important aspect to be considered in the selection of flexible laminate, besides the factors mentioned earlier, is the compatibility of the contact layer of the packaging substrate with that of the product packed inside. This needs to be viewed critically for spice powders of turmeric,

chilli, ginger, pepper as well as spice mixes containing these spices. The volatile oils present in these spices can react with the contact layer and cause stickiness and can also affect the printing. De-lamination of the substrates may also occur. For these products, it is best to avoid the use of LDPE (low density polyethylene) as the heat sealant or the food contact layer. The better option for sealant or contact layer could be co-extruded film of LD-HDPE (with HDPE in contact with the product) or cast polypropylene. Alternatively, ionomer (surlyn) or EAA (primacor) can also be considered as the sealant layers.

The types of pouches from flexible plastic based materials could be variable:

- Centre seal formation
- Three sides seal formation
- Four sides seal formation
- Strip pack formation

The vital link in the performance of the pouch is the seal integrity. The performance of the heat seal layer is very important. Even if the film structure has been designed with exceptional properties, with excellence in interlayer lamination, if the sealing of the pouch fails, the product may get contaminated and in some cases become unfit for consumption.

Among the semi-rigid packages, plastic containers, specially of stretch blown PET of different shapes are reported to be suitable for a shelf-life of about 180 days for masala mixes. PET containers have the advantage of being clear, light in weight and have the desired barrier properties.

Studies Conducted at IIP

Packaging of Whole Black Pepper

Traditionally black pepper was packed and traded in bulk quantities in gunny bags. A market study carried out indicated that the product would have better acceptability in the domestic as well as export market with improved packaging method, specially, by introducing a shift in the packaging trend from the practice of bulk packaging to modern concept of value addition through consumer packaging.

In the above context, the Institute had carried out an extensive study on shelf-life / storage of whole black pepper. The study involved evaluation of the traditional consumer packaging system in jute and cotton bags and comparing the performance of these packaging systems with modern flexible plastic based materials with respect to the keeping quality of the product.

Since it was observed that the whole black pepper exported by various exporters have different levels of moisture content at the time of packing, it was decided to conduct shelf-life studies of MG₁ grade black pepper at three different levels of initial moisture contents i.e. 10%, 11% and 12%.

It is, however, to be noted that as per BIS and AGMARK specifications, MG₁ grade black pepper should have a maximum moisture content of 11.50%. The studies conducted indicated that at this stage (11.5%), there was no apparent visual or organoleptic change in the product. When the product attained a moisture level of about 14%, fungus growth was detectable.

The shelf-life of black pepper (MG₁ – at three different moisture content levels) was carried out in the laboratory, at four different storage conditions.

The shelf-life / storage studies were carried out with eight different flexible packaging materials, which included the traditional cotton and jute bags. The parameters considered for the determination of shelf-life were moisture content, loss of aroma and appearance of fungus growth.

The results of the studies indicated that the conventional jute and cotton bags offer a lower shelf-life, particularly at accelerated and cyclic conditions of storage. Under these conditions there was loss of aroma, as well as moisture loss / gain beyond the acceptable limits. At the test conditions, where the relative humidity was high, the moisture pick-up was very rapid leading to fungus growth and deterioration of the product. In these packs, the shelf-life at normal conditions was 3 to 4 weeks.

From the results of the studies, it was concluded that the packaging materials which could offer the product a shelf-life of around one year and more at normal climatic conditions (27°C ± 1°C and 65% ± 2% RH) in order of performance are:

- a) 40 gsm paper / 0.12mm Al foil / 25µ LDPE
- b) 12µ metallised polyester / 50µ LDPE
- c) 25µ BOPP / 40µ LD – HD
- d) 12µ polyester / 50µ LDPE
- e) 90µ LD – Tie – Nylon – Tie – LD

The above materials (a, b, c & d are laminates and e is a co-extruded film) as well as other materials with similar barrier properties were recommended for use as consumer pack materials. These materials could be used as flat pillow pouches, gusseted pouch or stand-up pouches.

It is to be noted that over the period of years, the traditional packaging materials have been replaced by plastics based materials, recommended above as well as similar materials.

The study also concluded that if the upper moisture limit is 11.5%, then, at the time the product is packed, the moisture content should not be more than 10%. It is also significant to specify upper moisture levels/limits at the time the product is manufactured and packed, not only in the case of black pepper and spices, but also for all hygroscopic / moisture sensitive products.

Specifications Details for Packaging of Spices

Based on in depth studies conducted at the Institute, a set of packaging specifications have been drawn up for consumer packs, intermediate packs and bulk packs, in respect of different packaging materials that are suitable. Specification details with respect to some of plastics based packages are given in appendix Tables 2A, 2B, 2C and 2D (at the end of the article) for consumer packs and in appendix Tables 3A and 3B (at the end of the article) for bulk packs.

Studies Conducted at CFTRI

Spice Powders

CFTRI, Mysore has carried out detailed storage studies for spice powders like pepper, turmeric, cumin, coriander and chilli. The studies were carried out in 100 gram capacity pouches of flexible packaging materials at accelerated storage conditions of 38°C, 92% RH and standard conditions of 27°C, 65%R.H. The approximate shelf-life of different spice powders under the two storage conditions is given in appendix Tables 4A and 4B (at the end of the article).

The results of the study indicate that for long time storage at standard conditions of 27°C, 65% R.H. the materials which are suitable are laminates of cello / poly, metallised polyester / poly and paper / foil / poly which offer shelf-life of 200 days, one year and over one year respectively. Pouches of mono films of 200-gauge polypropylene or high density polyethylene can be considered for short term storage of about 90 days.

Dry Herb Powders

Culinary herbs are traded internationally as dried herbs. Ground herbs are sensitive and are prone to various types of changes such as loss of volatile oil, free flow property, microbial spoilage and insect infestation. Light and oxygen bring about discolouration. Losses of essential oils can also occur resulting in deterioration in the quality of herb powders.

Studies on powders of dehydrated rosemary, curry leaves and marjoram were undertaken to determine the storage life of these products. The storage studies were carried out in three rigid containers made of glass, high density polyethylene (HDPE), polyethylene terephthalate (PET) and also using a flexible Al foil laminated pouch at accelerated conditions

of 38°C, 92% RH and standard conditions of 27°C, 65% R.H. The herb powders were analysed at fixed intervals of time for quality parameters such as:

- Moisture content
- Volatile oil content
- Chlorophyll content
- Colour

The results of the study indicate that for a long shelf-life of more than 6 months, the suitable packages are glass bottles and pouches of Al foil laminate. For a shorter storage life of 3 to 6 months at standard conditions, PET and HDPE containers are suitable.

“Guntur” and “Byadigi” Varieties of Chillis

Chillis are cultivated as one of the most important cash crops in India. During 1999-2000 India earned Rs. 2166 millions from export of 61,253 tonnes of chillis (Spices Board 2000).

Chillis are valued for their colour and pungency (the active principle of pungency is capsaicin). CFTRI, Mysore had undertaken studies to see the effect on the quality with respect to colour and capsaicin in “Guntur” and “Byadigi” dried whole chillis packed in 75µ high density polyethylene (HDPE) and 12µ metallised polyester / 37µ LDPE pouches of 250 grams capacity. The studies were carried out at three different conditions – accelerated (38°C, 90 ± 2% R.H.), ambient (27°C, 65% R.H.) and controlled (4-5°C). The unit packs were withdrawn at intervals of 45 days and assessed for quality with respect to parameters like:

- Surface colour
- Texture
- Mold Attack
- Moisture content
- Colour Retention
- Capsaicin content

Appendix Tables 5A & 5B (at the end of the article) indicate the mean values obtained during the study.

The result indicated that the “Guntur” and “Byadigi” chillis (250g each) packed in HDPE and metallised polyester / LDPE pouches had better colour even after 180 days at 4-5°C than at ambient conditions. However, the retention of colour in metallised polyester / LDPE pouches was better than HDPE pouches at 4-5°C and at ambient conditions, irrespective of the chilli variety. Under accelerated conditions (38°C, 90% RH), shelf-life for “Guntur” and “Byadigi” chillis in both the packages was less than 45 days (data not included in the tables). The discolouration of red pigment of chillis during storage was highly influenced by moisture and temperature. The capsaicin content showed a decreasing trend irrespective of storage conditions, packaging material and chilli varieties. Under identical storage conditions and packages, “Guntur” chillis had better shelf-life than “Byadigi” chilli.

[Sources: Reference numbers 3, 6 and 7]

Oleoresins and volatile oils are obtained from ground dried spices and have a good potential in the export trade. These products are sensitive to light and are highly volatile in nature and therefore need to be suitably packed and protected. The spices mainly used for extraction are pepper, chillies, turmeric and ginger. These products are packed in epoxy coated narrow mouth aluminium container of 1 to 5 litres capacity. Stretch blown PET bottles are also being used because of their excellent barrier properties to oxygen and volatile oils and compatibility with the product. 5 litres food grade HDPE Jerry cans and 25kg wide mouth HDPE containers with high thickness are also used.

Conclusion

Spices are distributed in whole, ground and paste form in consumer as well as in bulk packs. Most traditional materials used earlier like paper, tinsplate containers and jute bags are being replaced by plastics materials for packaging of these products. Plastics are preferred due to their properties such as light weight, easy availability, compatibility, hygienic nature machineability, printability, heat sealability and selective barrier properties.

APPENDIX TABLE 2A
Specification Details for Whole and Ground Spices – Consumer Packs
Flexible Pouch Systems
(A) Ground Spices

(i) Other than Chilli powder, Turmeric powder, Curry powder and Masala powder

Laminates / Co-extruded films (up to 500 grams capacity)	Laminates / Co-extruded films (up to 1000 grams capacity)
12µ PET / 37.5µ LDPE	12µ PET / 50µ LDPE
12µ MET PET / 37.5µ LDPE	12µ MET PET / 50µ LDPE
12µ PET / 37.5µ PP	12µ PET / 50µ PP
12µ MET PET / 37.5µ PP	12µ MET PET / 50µ PP
10µ PET / 9µ Al. foil / 37.5µ LDPE	10µ PET / 9µ Al. foil / 50µ LDPE
12µ Al. foil / 37.5µ LDPE	12µ Al. Foil / 50µ LDPE
25µ BOPP / 37.5µ LDPE	25µ BOPP / 50µ LDPE
25µ MET BOPP / 37.5µ LDPE	25µ MET BOPP / 50µ LDPE
25µ BOPP / 25µ BOPP	30µ BOPP / 30µ BOPP
30µ LDPE – 7.5µ Tie - 25µ PA – 7.5µ Tie - 30µ LDPE	30µ LDPE – 7.5µ Tie - 30µ PA – 7.5µ Tie - 30µ LDPE
The Innermost and Outermost Layer of LDPE could be LLDPE or EAA	The Innermost and Outermost Layer of LDPE could be LLDPE or EAA

APPENDIX TABLE 2B
Specification Details for Whole and Ground Spices – Consumer Packs
Flexible Pouch Systems
(A) Ground Spices

(ii) Chilli powder, Turmeric powder, Curry powder and Masala powder

Laminates/Co-extruded films (up to 500 grams capacity)	Laminates/Co-extruded films (up to 1000 grams capacity)
12µ PET / 37.5µ LD-HD (30% HD)	12µ PET/50µ LD-HD (30% HD)
12µ MET PET / 37.5µ LD-HD (30% HD)	12µ MET PET / 50µ LD-HD (30% HD)
12µ PET / 50µ PP	12µ PET / 62.5µ PP
12µ MET PET / 50µ PP	12µ MET PET / 62.5µ PP
10µ PET / 9µ Al. foil / 37.5µ LD-HD (30% HD)	10µ PET / 9µ Al. foil / 50µ LD-HD (30% HD)
12µ Al. foil / 37.5µ LD-HD (30% HD)	12µ Al. foil / 50µ LD-HD (30% HD)
25µ BOPP / 37.5µ LD-HD (30% HD)	25µ BOPP / 50µ LD-HD (30% HD)
25µ MET BOPP / 37.5µ LD-HD (30% HD)	25µ MET BOPP / 50µ LD-HD (30% HD)
35µ BOPP / 25µ BOPP	35µ BOPP / 35µ BOPP /
30µ LD – 7.5µ Tie - 25µ PA – 7.5µ Tie - 30µ LD-HD (30% HD)	30µ LD – 7.5µ Tie - 30µ PA – 7.5µ Tie - 40µ LD-HD (30% HD)
The LD or LD-HD layer could also be LLD (outer) or LLD-HD (inner or outer) or EAA layer (outer)	The LD or LD-HD layer could also be LLD (outer) or LLD-HD (inner or outer) or EAA layer (outer)

APPENDIX TABLE 2C
Specification Details for Whole and Ground Spices – Consumer Packs
Flexible Pouch Systems
(B) Whole Spices

(i) Other than Pepper and Cardamom

Laminates / Co-extruded films (up to 500 grams capacity)	Laminates / Co-extruded films (up to 1000 grams capacity)
50μ HD – LD	62.5μ HD – LD
50μ HD – LD – HD	62.5μ HD – LD – HD
12μ PET / 37.5μ LD	12μ Polyester / 50μ LD
25μ BOPP / 37.5μ LD	25μ BOPP / 50μ LD
12μ PET / 37.5μ PP	12μ PET / 50μ PP
25μ LD – 7.5μ Tie – 25μ PA – 7.5μ Tie – 25μ LD	30μ LD – 7.5μ Tie – 25μ PA – 7.5μ Tie – 30μ LD
The LDPE Inner and Outer layers could also be LLDPE or EAA or LD-HD	The LDPE Inner and Outer layers could also be LLDPE or EAA or LD-HD

APPENDIX TABLE 2D
Specification Details for Whole and Ground Spices – Consumer Packs
Flexible Pouch Systems

(ii) Pepper and Cardamom

Laminates / Co-extruded films Up to 500 grams	Laminates / Co-extruded films Up to 1000 grams
12 μ PET / 37.5 μ LD	12 μ PET / 50 μ LD
12 μ MET PET / 37.5 μ LD	12 μ MET PET / 50 μ LD
25 μ BOPP / 37.5 μ LD	25 μ BOPP / 50 μ LD
50 gsm paper / 9 μ Al. foil / 37.5 μ LD	50 gsm paper / 9 μ Al. foil / 50 μ LD
35 μ BOPP / 25 μ BOPP	30 μ BOPP / 25 μ BOPP
30 μ LD – 7.5 μ Tie – 25 μ PA – 7.5 μ Tie 30 μ LD	30 μ LD – 7.5 μ Tie – 25 μ PA - 7.5 μ Tie – 30 μ LD
The LDPE Inner and Outer layers could also be LLDPE or EAA or LD-HD	The LDPE Inner and Outer layers could also be LLDPE or EAA or LD-HD

Note:

For all flexible pouch systems

While the above are indicative types of laminates and co-extruded films that are recommended, any other flexible laminates or co-extruded films comparable to the barrier and strength properties of above type of laminates or co-extruded films would also be acceptable.

1. Tolerances (Lower level permissible)
 - Polyester films (-5%)
 - Polyethylene films (-10%)
 - Polypropylene films (-10%)
 - BOPP films (-5%)
 - Al. foils (-5%)
 - Co-extruded films (-10%)
2. The laminate / co-extruded film could be transparent / opaque / coloured as per the requirement of the importer.
3. All the materials used shall be of food grade and pass the prescribed Indian standard / standards, if and as demanded by importing countries.
4. Printing requirements shall conform to as demanded by Spices Board and export requirements.

APPENDIX TABLE 3A
Specification Details for Whole and Ground Spices – Bulk Packs

Whole Spices/Seed Spices		Direct Bulk
Product: Chillies, Ginger, Turmeric, Fenugreek, Coriander, Cumin Seeds		Capacity : 40 kg/ 50 kg/ 70 kg/
1. Type of fabric/material	:	HDPE Woven flat or HDPE or PP woven circular fabric. (*Loose liner bag optional)
2. Denier	:	1000
3. Ends/dm	:	50 ± 5
Picks/dm	:	50 ± 5
4. Breaking load (kgf)		
Warpway	:	85 ± 5
Weftway	:	85 ± 5
5. Seam Strength (kgf)		
Bottom	:	39 ± 2
Side	:	35 ± 2
6. Stitching	:	Shall be 10 mm from the edge. The number of stitches per 10 cm shall be between 9 and 11.

* Instead of using a loose liner bag, the woven sack could also be laminated with low density polyethylene.

NOTE: Wherever tolerances are not indicated, the value to be considered as minimum value.

HDPE – High Density Polyethylene

PP – Polypropylene

APPENDIX TABLE 3B

Specification Details for Whole and Ground Spices – Bulk Packs

Ground Spices Product: Curry Powder, Curry Mixes, Chilli Powder, Coriander Powder Turmeric Powder		Direct Bulk Capacity : 50 kg
1. Type of fabric/material	:	HDPE Woven flat or HDPE or PP woven circular fabric with a loose liner bag *
2. Denier	:	1000
3. Ends/dm	:	50 ± 5
Picks/dm	:	50 ± 5
4. Breaking load (kgf)		
Warpway	:	85 ± 5
Weftway	:	85 ± 5
5. Seam Strength (kgf)		
Bottom	:	39 ± 2
Side	:	35 ± 2
6. Stitching	:	Shall be 10 mm from the edge. The number of stitches per 10 cm shall be between 9 and 11.

* Instead of using a loose liner bag, the woven sack could also be laminated with low density polyethylene.

NOTE: Wherever tolerances are not indicated, the value to be considered as minimum value.

HDPE – High Density Polyethylene

PP – Polypropylene

APPENDIX TABLE 4A
Probable Shelf-life of Ground Spices in Different Flexible
Pouches in 100g. Consumer Packs at 92% RH & 38°C
(Accelerated Storage Condition)

Sl. No.	Pouch Packaging Material	Pepper		Turmeric		Cumin		Cori- ander	Chilli
		S.L.*	% loss**	S.L.*	% loss**	S.L.*	% loss**	S.L.*	S.L.*
	Initial Moisture Content (% by wt.)	9.5		9.5		6.0		6.0	6.0
	Critical moisture content (% by wt.) w.r.t. caking & lumping	11-12		11-12		10-11		10-11	10-11
1.	200 g*** (LDPE) low density polyethylene	30	80	25	35	70	75	80	—
2.	350 g LDPE	50	75	45	30	—	—	—	60
3.	200 g (HDPE) high density polyethylene	60	75	—	—	—	—	—	70
4.	200 g Polypropylene (PP)	40	50	35	30	70	50	—	—
5.	350 g PP	60	60	50	20	—	—	—	—
6.	300 MXXT Cellophane	25	10	30	5	—	—	70	—
7.	Double pouch of glassine gusset inside + 250 g LLDPE	35	50	45	20	—	—	80	—
8.	Double pouch of 300 MSAT cellophane inside + 250 g LDPE	40	10	45	15	80	10	80	—
9.	Glassine / 150 g Polyamide	—	—	20	5	—	—	—	—
10.	Saran coated cello / poly laminate	—	—	40	5	—	—	—	50
11.	Metallised polyester 12µ / 150 g LDPE laminate	120	20	120	10	120-150	30	150-180	150-180
12.	Paper / 9µ Al / foil / 150 g poly	expected 1 yr.	21	expected 1 yr.	5	expected 1 yr.	—	expected 1 yr.	expected 1 yr.

* Shelf-life (in days) with respect to caking and lumping.

** % loss of volatile oil at the end of 180 days.

*** g: gauge

APPENDIX TABLE 4B
Probable Shelf-life of Ground Spices in Different Flexible
Pouches in 100 g Consumer Packs at 65% RH & 27°C
(Indian Standard Condition)

Sl. No.	Pouch Packaging Material	Pepper		Turmeric		Cumin		Cori- ander S.L.*	Chilli S.L.*	Remarks on Packaging Materials
		S.L.*	% loss** of V.O.	S.L.*	% loss ** of V.O.	S.L.*	% loss ** of V.O.			
	Maximum moisture content (% by wt. of the product in an atmosphere of 65% RH & 27°C	10.0		11.0		9.0		10.0	11.0	
1.	200 g*** LDPE	60	80	30	50	60	75	80	90	1,2,3,4 & 5 are good moisture Barriers but poor volatile Barriers
2.	350 g LDPE	60	75	30	50	60	—	60	90	
3.	200 g HDPE	90	75	60	—	90	—	90	120	
4.	200 g Polypropylene (PP)	90	65	60-90	40	90	45	120	150	
5.	350 g PP	120	60	60-90	20	120	—	150	200	
6.	300 MXXT Cellophane	200	10	200	10	200	—	200	200	
7.	Double pouch of glassine gusset inside + 250 g LDPE	120	50	120	15	120	—	150	150	
8.	Double pouch of 300 MSAT cellophane inside + 250 g LDPE	200	10	200	10	200	20	200	200	

APPENDIX TABLE 4B
Probable Shelf Life of Ground Spices in Different Flexible
Pouches in 100 g Consumer Packs at 65% RH & 27°C
(Indian Standard Condition)

Sl. No.	Pouch Packaging Material	Pepper		Turmeric		Cumin		Cori- ander S.L.*	Chilli S.L.*	Remarks on Packaging Materials
		S.L.*	% loss** of V.O.	S.L.*	% loss ** of V.O.	S.L.*	% loss ** of V.O.			
9.	Glassine / 150 g poly	120	—	120	15	120	—	120	150	9. 10. Fairly moisture proof, good
10.	Saran coated cello/poly	200	—	200	10	200	—	200	200	Barrier to V.O.
11.	Metallised polyester 12 µ / 150 g LDPE	1 yr.	10-20	1 yr.	20-30	1 yr.	10	1 yr.	1 yr.	11. good moisture & V.O. barrier
12.	Paper / 9 µ Al foil/150 g poly	1 yr.	5	1 yr.	10	1 yr.	—	1 yr.	1 yr.	12. very good moisture & V.O. barrier

* Shelf-life w.r.t. overall quality refers to probable quality changes due to considerable loss in volatile oil, colour & flavour leading to overall loss – freshness of ground spices.

* As the product attains the maximum moisture content which is slightly below the critical level of moisture, the shelf-life with respect to lumping or caking is not a problem at and below 65% R.H. & 27°C

** % loss of volatile oil at the end of 120 days

*** g: gauge

APPENDIX TABLE 5A
'Guntur' Chillis – Statistical Significance of Mean Values
for effect of Packaging, Temperature and Storage Period

Storage Period, Days	Packaging		Temperature		Overall Mean Storage Period (Significance)
	HDPE	MPP	Refrigerator	Ambient	
Moisture, %					
45	9.20	9.20	9.20	9.20	9.20 ^a
90	9.55	9.20	9.20	9.55	9.38 ^b
135	9.45	9.25	9.15	9.55	9.35 ^b
180	9.45	9.10	9.00	9.55	9.28 ^b
Overall mean (significance)	9.41 ^m	9.19 ^l	9.14 ^x	9.46 ^y	SE _m = 0.0577 (32 df)
Colour Value					
45	2267	2716	2631	2352	1176 ^d
90	2034	2276	2372	1938	969 ^c
135	1941	2168	2255	1854	927 ^b
180	1895	2134	2228	1802	90 ^a
Overall mean (significance)	2034 ^l	2324 ^m	2372 ^y	1986 ^x	SE _m = 0.9000 (32 df)
Capsaicin, %					
45	0.38	0.38	0.35	0.40	0.38 ^d
90	0.32	0.34	0.35	0.30	0.33 ^c
135	0.32	0.32	0.35	0.28	0.32 ^b
180	0.28	0.28	0.32	0.24	0.28 ^a
Overall mean (Significance)	0.32 ^l	0.33 ^l	0.34 ^y	0.31 ^x	SE _m = 0.0006 (32 df)

SE_m (df) – Standard error of the means (degree of freedom). Any two means corresponding different superscripts, l, m or x, y in rows and a,b,c,d in columns differ significantly (P≤0.05).

APPENDIX TABLE 5B

'Byadigi' Chillis – Statistical Significance of Mean Values
for effect of Packaging, Temperature and Storage Period

Storage Period, Days	Packaging		Temperature		Overall Mean Storage Period (Significance)
	HDPE	MPP	Refrigerator	Ambient	
Moisture, %					
45	9.90	9.90	9.90	9.90	9.90 ^b
90	10.95	9.95	9.80	10.20	10.00 ^b
135	9.60	9.50	9.65	9.50	9.55 ^b
180	9.55	8.70	9.30	9.05	9.12 ^a
Overall mean (significance)	9.78 ^m	9.51 ^l	9.66 ^x	9.63 ^y	SE _m = 0.2387 (32 df)
Colour value					
45	4879	5580	5321	5138	5230 ^b
90	3368	3798	3989	3177	3583 ^a
135	3228	3744	3915	3057	3486 ^a
180	3199	3680	3900	2978	3439 ^a
Overall mean (significance)	3670 ^l	4200 ^m	4280 ^y	3590 ^x	SE _m = 120.20 (32 df)
Capsaicin, %					
45	0.26	0.24	0.26	0.24	0.25 ^d
90	0.20	0.20	0.20	0.20	0.20 ^c
135	0.18	0.18	0.19	0.16	0.18 ^b
180	0.14	0.15	0.15	0.14	0.15 ^a
Overall mean (Significance)	0.20 ^l	0.19 ^l	0.20 ^y	0.19 ^x	SE _m = 0.0006 (32 df)

SE_m (df) – Standard error of the means (degree of freedom). Any two means corresponding different superscripts, l, m or x, y in rows and a,b,c,d in columns differ significantly (P≤0.05).

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