Bulk Packages for Storage and Transportation of Salted and Dried Fish

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The effect of bulk packaging on the storage of salted and dried fish was studied at ambient conditions. Four different packaging systems were tried, among which gussetted type high density polyethylene woven sacks having either circular loom or traditional loom laminated with 100 gauge low density polyethylene were found to be best suited for dry fish packaging as they could withstand the hazards of handling, transportation and storage.

Preservation of fish by salting and drying is an age-old practice throughout the world and is by far the simplest and cheapest method. About 20% of the total fish catch in India is preserved by this method at present. In the year 1985, 9022 tonnes of dry fish valued at Rs. 79.5 millions were exported from India. The uneconomic price fetched by the product in the export market can largely be attributed to its low quality and the unhygienic and unattractive packages used for storage and transportation.

There are certain special problems associated with dry fish. First of all, it has an irregular shape, leading to difficulty in assembling in a neat package. Another important draw back is that it has spines which may puncture the package. In a porous package like the jute bag, the dry fish may pick up or lose moisture according to season, both of which are undesirable.

An ideal bulk packaging system for dried fish should be inert, leak proof, impermeable to air and moisture, opaque, resistant to mechanical abrasion and puncture and inexpensive (Gopal *et al.*, 1981). Besides, it should be insect proof and should withstand heat and ultra-violet rays. The present paper deals with bulk packaging of salted and dried shark superficially treated with 0.1% calcium propionate in four different containers and evaluating their suitability for the purpose.

Materials and Methods

Freshly salted and dried commercial sample of shark was purchased from the Calicut dry fish market and used in the present studies. The moisture content of the product was brought down to 35% the maximum limit prescribed (IS: 4302 – 1967). The fish was then superficially treated with 0.1% calcium propionate and packaged in (1) gussetted high density polyethylene (HDPE) woven sacks having circular loom and laminated with 100 gauge low density polyethylene (LDPE) (2) pillow type multiwall paper sacks made of 90 gsm kraft paper (5 liners) with 300 gauge LDPE liner inside (3) gussetted jute sacks lined inside with 200 gauge LDPE (4) gussetted HDPE traditionally woven sack laminated inside with 100 gauge LDPE. The dry fish superficially treated and conventionally packed in palmirah mat and jute sack was kept as control. One pack each was used for the four different materials and control. Gussetted jute sack, both types of gussetted HDPE woven sacks and the control package were packed with 50 kgs each of dry fish, whereas the multiwall paper sacks were packed with 20 kgs each. The packs were stored at ambient conditions, RH varying from 65 to 95% and temperature from 25 to 34°C. The gussetted jute sacks used in this experiment were made according to our specifications by Jute Technological Research Institute, Calcutta and HDPE gussetted bags by a private firm at Cochin, as per the given

specifications. Stackability was tested by carrying out the experiment in a commercial establishment.

Initial analyses for moisture content, sodium chloride, fat, protein, acid insolubles and ash were conducted according to AOAC (1975) methods. The reconstitution values were determined by the method of Sen *et al.* (1961). Samples were withdrawn at intervals of one month, analysed for the above chemical indices and subjected to organoleptic evaluation.

Physical properties of the packaging materials such as the tensile strength of HDPE woven and jute fabrics were tested as per IS: 6899 (1984) and IS: 8115 (1978) respectively and the tensile strength for multiwall paper sack were estimated as per IS: 1060 Part I (1966). Filled packages were subjected to drop test and roll test as per IS: 7028 Part 1–9 (1973).

Results and Discussion

Table 1 presents the results of initial anasis of dried shark after bringing down the moisture content and before superficial treatment with calcium propionate. Changes in moisture, reconstitution properties and organoleptic rating during storage are presented in Tables 2, 3 and 4 respectively. Table 5 presents the physical properties of the packaging materials and result of endurance test of filled packages. The moisture content did not vary much in all cases except the control sample in which it decreased first in the summer to 29.6% and in the rainy season the material picked up moisture up to 42.99% in a span of 90 days. In spite of chemical treatment the latter material showed discolouration, intense ammonical smell and appearance of insects after three months of storage and hence it was discarded at that stage. This clearly proved that the protective property of the chemical preservative could not manifest itself when used without proper package at high humidity conditions. Initial reconstitution value was 10.36 g of water per 10 g of sample on salt and moisture free basis. Retention of reconstitution property was comparatively better in the control sample as seen from Table 3, whereas considerable decreases were noticed in all other cases. However the general trend was a decreasing one with storage time.

Table 1. *Initial analysis of the salted dried shark*

Moisture%	35.42
Fat % (DWB)	0.82
Crude protein % (DWB) (N x 6.25)	60.72
NaCl % (DWB)	22.18
Ash % (DWB)	26.35
Acid insolubles % (DWB)	0.45
Reconstitution	10.36 g water/10 g of moisture and salt free sample

DWB – Dry weight basis

Table 2. *Changes in the moisture contents (%) of the salted dried, treated and packed shark stored at ambient conditions in different packages*

Period of storage, months	1	2	3	4	5	6	7
Control	29.60	37.99	42.89	—	—	—	—
HDPE circular woven sack	35.70	36.70	35.88	34.39	35.23	35.27	35.78
Multiwall paper sack	36.91	35.80	37.11	36.12	35.11	34.82	—
Jute sack	36.70	37.80	37.33	36.13	35.89	—	—
HDPE traditional sack	36.19	36.23	35.23	35.23	35.18	37.42	36.65

Table 3. *Changes in reconstitution properties of salted dried and treated shark stored at ambient conditions as g water/100 g on moisture and salt free samples*

Period of storage, months	1	2	3	4	5	6	7
Control	8.413	10.35	10.53	—	—	—	—
HDPE circular woven sack	10.30	9.64	9.22	10.23	8.75	8.49	8.55
Multiwall paper sack	10.20	8.75	9.52	9.35	8.57	7.88	—
Jute sack	11.52	10.75	8.88	8.98	8.52	—	—
HDPE traditional sack	10.25	10.30	9.75	9.95	9.20	8.52	8.75

Note: Initial value 10.36

Table 4. *Changes in organoleptic qualities of salted dried, treated and bulk packed shark at ambient conditions*

Period of storage in months	Initial	1	2	3	4	5	6	7
Control	Whitish, very good	Fair, changes in colour slightly fibrous	Fair, changes in colour and light ammoniacal odour	Poor, red growth and ammoniacal, appearance of insects	—	—	—	—
HDPE circular woven sack	,,	Good normal taste and smell	Good, normal taste	Good, slightly fibrous, normal taste	Good to fair, slight ammoniacal smell	Fair, slight, ammoniacal, normal taste	Fair to poor, Ammoniacal, normal taste lost	Poor, heavy ammoniacal odour, soft not acceptable
Multiwall paper sack	,,	,,	,,	,,	,,	Fair to poor, ammoniacal, taste lost	Poor, heavy ammoniacal smell discarded	—
Jute sack	,,	,,	,,	Good to fair, ammoniacal normal taste	Fair, ammoniacal flat taste	Poor, red growth, heavy ammoniacal odour	—	—
HDPE traditional sack	,,	,,	,,	Good, ammoniacal, normal taste	Fair, slight, ammoniacal smell	Fair, slight ammoniacal, normal taste	Fair to poor ammoniacal normal taste lost	Poor, ammoniacal odour, soft not, acceptable

Table 5. *Physical properties of packaging materials and endurance tests of filled packages*

Description of package	Physical properties: Size and net weight	Tensile strength (kg)		Endurance tests on filled packages: Drop test (1 metre)	Roll test 20 Rolls	Stackability without slip	Cost	Remarks
1. HDPE woven sack, circular loom laminated with 100 gauge low density polythene, 50 kg capacity	61×61×30 cm 150 g	Warp weft	75.5 54.5	No damage	No damage	6	Rs. 12	Better stacking is possible because of the gusseted shape
2. HDPE traditional woven sack laminated with 100 gauge LDPE 50 kg capacity	61×61×30 cm 165 g	Warp weft	72.3 46.4	,,	,,	6	,,	,,
3. Multiwall paper sack of 90 gsm kraft (5 liner) lined inside with 300 gauge LDPE, 20 kg capacity	84×112.5 cm 620 g	MD CD	25.4 15	Broken at the stich line	,,	3	Rs. 10	Costlier, damaged during drop tests
4. Jute sack with 200 gauge LDPE loose liner (gussetted type) 50 kg capacity	61×61×30 cm 630 g	Warp	45.7	No damage to the sack, but PE lining broken	No damage to the sack but PE lining broken	7 Nos	Rs. 10	Stackability increased since it is gussetted
5. Control: palmirah mat inner and jute liner outer, 50 g capacity	115×65 cm 2.1 kg			No damage	No damage	3	Rs. 10	Poor hygiene, not water proof, easy external contamination and insect infestation.

The traditional packaging material and the jute sacks have similar properties since they have similar material and hence behaved in the same manner. Eventhough jute sacks were lined with polythylene film, the latter was damaged during roll test. The lining was broken leading to moisture absorption, the sack cloth getting a wet appearance in areas where the PE film got broken. Such breakage of PE lining can lead to rotting of the cloth material leading to contamination and rendering the package unhygienic. The jute cloth is a comparatively heavier material than HDPE woven sacks as seen from Table 5. Easy wetting of the jute cloth takes place because the dry fish is highly salted and somewhat hygroscopic in nature. Tensile strength of this material is also less than those of HDPE woven sacks. Even though 120 days of storage could be obtained with this material, it cannot be recommended for the above reasons. Once the polythene lining was broken, it gave way for easy entrance of insects also.

In the case of multiwall paper sacks having 300 gauge PE lining inside, the liners are of 90gsm and the package is six times as heavy as HDPE and costly. Besides the package failed when subjected to drop test, breaking at the stitch line. Hence the scope of using it for packaging dry fish gets extremely limited. The cost of the package also is comparatively higher than that of HDPE sacks.

HDPE gussetted bags laminated with 100 gauge LDPE used in these studies have shown very good advantages over other materials. As seen from Table 5, the physical properties of the material were much better than those of the others. HDPE being highly crystalline is hard and translucent. It has high tensile strength and less weight. Tests conducted on the filled packages proved beyond doubt that they can withstand all the handling hazards during transportation. Stackability is improved because of the gussetted design, having larger base area compared to the traditional pillow type bags. From hygienic point of view also, it is rot resistant and impervious to microbial organisms. It is water resistant and no insect attack occurred during the entire period of 180 days of storage. The cost of the package is slightly on the higher side compared to the traditional one as seen from Table 5. However this drawback is more than compensated by its various advantages mentioned above. Hence HDPE gussetted bags laminated with polyethylene are recommended for packaging dried fish under commercial conditions.

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References

AOAC (1975) *Official Methods of Analysis.* (Horwitz, W., Ed.) 12th edn., Association of Official Analytical Chemists, Washington

Gopal, T. K. Srinivasa, Antony, K. P. & Govindan, T. K. (1981) *Seafood Export J.* 13 (1), 1

IS: 1060–Part - I (1966) *Methods of Sampling and Test for Paper and Allied Products,* Indian Standards Institution, New Delhi

IS: 4302 (1967) *Specification for Dry Salted Mackerel,* Indian Standards Institution, New Delhi

IS: 7028 Part 1–9 (1973) *Performance Tests for Complete Filled Transport Packages,* Indian Standards Institution, New Delhi

IS: 8115 (1978) *Specifications for Durable Hessian Jute Bags for Pesticides,* Indian Standards Institution, New Delhi

IS: 6399 (1984) *Specifications for HDPE Woven Sacks,* Indian Standards Institution, New Delhi

Sen, D. P., Anandaswamy, B., Iyengar, N.V.R. & N. L. Lahiry (1961) *Food Science* (Mysore) 10, 5: 148