Def Sci J, Vol 34, No 2, April 1984, pp 193-198

Packaging Problems—Present and Future of Service Rations

A. N. SRIVATSA, V. SUBRAMANIAN AND T. R. SHARMA

Defence Food Research Laboratory, Mysore-570011

Received 4 January 1984

Abstract. Developments of food packaging from the early days of rigid containers up to the modern method of using flexible materials are revealed. Factors involving the selection for packing different types of Service rations are discussed. Future areas of research and development activity are outlined briefly.

1. Introduction

Packaging is an integral and important function of any food processing operation. Proper packaging protects, preserves and delivers the food in good, safe and acceptable condition to the ultimate consumer. It plays an importont role in maximising food distribution and consumption by reducing the wastage and pilferages; providing an efficient barrier against external contamination, spoilage due to moisture, oxygen, microbes, insects and rodents.

Selection of a particular packaging system for a product depends upon several parameters. The size and strength of the pack as well as that of the closure depends on (i) basic physical property of the food, its size, shape, density and the physical state, (ii) vulnerability of the product to environmental atmospheric conditions, resulting in change of state (solid to liquid, crisp to solid etc.), and (iii) hazards, vibrations, puncture and other mechanical damages to which it is likely to be subjected during transit and transportation. In the past, rigid containers made of metal, glass and wood played very prominent role in the development of packaging of foods, as it has been with the packing of other commodities.

Processed and semi-processed foods were and are being packed in rigid tin containers of various sizes, popularly known as OTS cans. Cans are light, easy to handle, readily opened, impervious to air, light and water and may be easily decorated, thus obviating the use of paper labels, which tend to get detached. The physical, chemical and bacteriological protection, expected from the can, require high degree of

precision. Method of manufacture of can and the several combinations of coatings for cans that have been developed have successfully met the conditions for packing all types of foods ranging from beer, vegetable products to dairy and meat products. The can has been the most important packing medium and has contributed largely to the progress and advancement of food processing industry.

Similarly, glass is one of the oldest materials known and has been traditionally used for packing liquids. Due to several inherent advantages of the glass, such as, inertness to alkalis, acids and solvents, excellent transparency, adaptability to high speed machines and availability in any desired colour, shape and size, glass container is a most popular form of packing. But its fragile nature, heavy weight and the increasing cost forced the industry to search for an alternative material for packing liquids. Although glass is a fairly inert and is used to contain strong acids and alkalies, as well as solvents, it has nevertheless, a definite and measurable chemical reaction with some materials, notably water, on long storage. The sodium is loosely combined with silicon and it is leached from the surface by plain water.

Wood had been the first choice for making bulk containers for the unit packs. But steadily diminishing timber resources have resulted in adopting the folding carton. It has become the most common type of container at present. The corrugated boards of varying plies, with any desired coatings have successfully replaced the heavy wooden containers to a large extent.

2. Flexible Packaging Materials

The use of flexible packaging materials for packing processed foods is continuously increasing. The avaliability of diverse combination films has enhanced the use of these materials in place of rigid containers.

Several varieties of protective papers, cellophanes, materials manufactured by condensation, polymerisation and addition polymerisation, co-extended polymers and laminates with metal foils have met specific requirements of the food packaging. These have been found to be more convenient and functionally more efficient.

Rigid and semi-rigid containers made by thermoforming, injection moulding and compression moulding are steadily replacing the conventional metal cans and bottles.

The choice of the particular plastic material for food packing has to be carefully made. It is governed by a number of considerations.

The material should possess the physical characteristics to protect the contents against the mechanical and physical damage and against atmospheric conditions. It must possess the appropriate tensile, impact and seal strength, permeation rates for moisture, oxygen and gases, and chemical compatibility with the products or components of the contents.

Next, the form in which the material is required should be carefully considered. If it is to be a wrapping material, it must be a film. For liquids or powders, it must

be in the form of a bag, blown bottles, pouch, blister or a tube. Each of these forms places a limitation upon the type of the material to be used.

Finally, exhaustive testing procedures have to be evolved to study the behaviour of the material under extreme conditions of stress, both mechanical and atmospheric.

Of the several flexible materials available, different varieties of paper are perhaps the oldest. Paper bag is still the most popular form of packaging. Its greatest advantage is the lowest unit cost. Papers with good barrier materials, such as, grease proof paper and glassine paper are being widely used for packing dairy products, toffees and dry materials. However, the non-supporting nature of the paper bag and relatively poor mechanical strength and barrier properties have limited the use of paper.

Different grades of regenerated cellulose with different coatings to enhance the functional properties are readily available and are being used. Polyvinylidine chloride, popularly known as Saran, as a coating on cellophane has greatly broadened the use of cellophane by enhancing the barrier against oxygen.

Some ethylene polymeric materials like polyethylene (LDPE and HDPE), polypropylene, polyvinyl chloride and laminates with aluminium foil have offered a whole new set of properties and usefulness.

R & D work in the field of food packaging is mainly concentrated on (i) evolving suitable standards in respect of indigenously available packaging materials suitable to the needs for food packaging and also attainable by the industry, and (ii) utilisation of the available packaging materials and technology for packing raw and processed foods.

Cellulose films as such have several limitations to be used as a primary barrier packaging for packing foods. The poor resistance to the permeability of water vapour, oxygen, vulnerability to atmospheric conditions and difficulty in attaining proper seals have limited the use of cellophane. However, laminates of cellulose with polyethylene of various thickness have a potential for packing foods, especially oil based materials like pickles in oil. Coating of the laminates with oxygen resistant coatings like polyvinylidine chloride has greatly enhanced the utility.

For packaging Service rations, cellulose film finds use only as an inner wrapper. In such cases, the outer packaging provides the main protection against moisture, oxygen and odours. Since cellulose film is in intimate contact with food, its purity and freedom from contaminating odour are of highest importance. It is necessary that the film is manufactured from good grade wood pulp, which should be reflected in its good mechanical strength.

Polyethylene film is mainly used for packaging of dry, non-fatty items, without a strong flavour/odour.

Consistency of quality of these films is of paramount importance for food packaging. Thickness, tensile strength, elongation at break, impact resistance, extractability, bursting strength and odour and flavour contamination determine the suitability of the material for food packing. These have been determined for cellulose,

polyethylene and cellopoly laminates. Based on the survey, modifications have been suggested. It has also been pointed out that the indigenous industry has got the capability to manufacture the food grade films.

Similarly, various quality parameters for regenerated cellulose-polyethylene laminates and aluminium foil laminates have been studied and appropriate modifications, so as to suit food packaging needs, have been suggested.

A three dimensional flexible pack for freeze dried meat based on indigenously available 60g BC paper/0.04 mm Al foil/150g LDPE was developed. This has been extensively tested and evaluated during several handling and transporting operations.

Intermediate moisture foods like breads, chapaties, khoa etc. have a very short life of 2-3 days. A fungistatic wrapper has successfully extended the shelf life. These wrappers contain 2g of sorbic acid per square metre. Sorbic acid in the form of a water based emulsion is coated on grease proof paper and dried. The coated papers when used as a wrapper for the above foods successfully preserve the above foods up to 6-8 weeks against fungal spoilage.

Similarly, packaging requirements of pickle in oil, whole milk powder, preserved chapaties and pre-cooked dehydrated foods have been evaluated and suitable packaging systems developed.

The availability of the material and advanced laminating techniques have resulted in flexible packs known as retort pouches or inpack processed foods. Flexible processable pouch has several advantages over the traditional sanitary cans. It requires shorter processing time resulting in saving energy. It retains better flavour, colour and texture of the food because of the minimised thermal damage. It is lighter and requires less storage space. It is easily disposable.

In the absence of a suitable laminate, a packaging system, using polypropylene and conditions of processing several ready to eat Indian foods have been developed. This has opened a new field of highly sophisticated technology.

3. New Areas of Research/Development Activity

In spite of the continuous R & D activity in the field of packaging, more efforts are required to meet the future needs because of its pivotal role in manufacturing activity. Due to the dwindling tin resources, several methods have been developed for tin coating of the base metal for manufacturing cans. This has resulted in considerable saving in tin.

The three types of tin free steel, viz., (i) chrome coated steel with a layer of chromium oxide on top of the chromium, (ii) chemically passivated steel, with a phosphate-chromate films on the surface and (iii) aluminium coated steel, must be further studied for large scale utilisation, and conditions and equipments used be standardised.

Light weight and resistance to atmospheric corrosion make aluminium very attractive as a container metal. Since it can be extruded, drawn and thinned, it is suited for making cans. However, its use is restricted to beverages only. With the abundant availability of the aluminium resources, R & D effort is required to develop a suitable aluminium alloy and special coatings for use with different types of foods.

Rigid containers like glass bottles and tin cans are the major components of packaging of liquids and semi-liquids (both alcoholic and non-alcoholic beverages). Considerable progress has been achieved for packing milk in non-returnable plastic pouches. However, these had created very little impact especially in case of alcoholic beverages. Considering the inherent advantages of flexible packaging, intense R&D efforts are required to develop a suitable flexible packaging material as well as a packaging system, with appropriate barrier and mechanical properties. This requires development of a new type of polymer with minimum additives, which are safe for packing food.

The existing flexible films have a number of limitations to be used for packing different types of food. New flexible films and laminates with superior functional properties, with better and higher flexibility (low flexural fatigue), higher tensile strength and better resistance to high temperature are required for high temperature processing operations. These can be achieved by development of suitable polymer blends of copolymers ethylene, isobutylene with other ingredients like resins and reinforcing fillers. Similarly, coextrusion of polymers with specific properties have to be developed.

Adhesive laminations with adhesives which are safe and which are not leached into food are not yet fully developed. Attention is urgently required in this area.

Standardisation and evaluation of packaging material is a continuous task. With the introduction and availability of new packaging materials, evaluation has to be carried out systematically and continuously till suitable specifications are evolved.

With diminishing petroleum resources and forest materials, steps to optimise and standardise the traditional and renewable raw materials for packing operations have to be undertaken.

The food systems for certain specific missions require a packaging technology which is entirely different to meet certain unusual stress conditions. This requires a sustained R&D work and vigorous and uncompromising testing procedures to ensure optimum performance. Facilities have to be created in this direction.

4. Conclusion

Packaging systems involving different types of raw materials have richly contributed to the growth of packaging industry and optimisation of food preservation and distribution and feeding people under specific conditions. Continuous efforts will further help the preservation and distribution of food products, by minimising waste and providing shelf life.

References

1. Kameswara Rao, G., Malathi, M. A. & Vijayaraghavan, P. K., *Food Tech.*, **18** (1964), 108.
2. Ghosh, K. G., Kameswara Rao, G., Sripathi Achar, K. & Vijayaraghavan, P. K., *Ind. Food Pack.*, **19** (1965), 11.
3. Vidyasagar, K., Aswathanarayana, T. M., Nirmala, N., Ghosh, K. G., Ramanujam, S. & Kameswara Rao, G., *J. Fd. Sci. Tech.*, **2** (1965), 60.
4. Kameswara Rao, G., Malathi, M. A. & Vijayaraghavan, P. K., *J. Fd. Sci. Tech.*, **20** (1966), 94.
5. Ghosh, K. G., Sripathi Achar, K., Srivatsa, A. N., Ramanujam, S., Kameswara Rao, G. & Vijayaraghavan, P. K., *J. Fd. Sci. Tech.*, **5** (1968), 12.
6. Kannur, S. B., Eapen, K. C., Mohan, M. S., Aswathanarayana, T. M., Ramanujam, S. & Vijayaraghavan P. K., *J. Fd. Sci. Tech.*, **5** (1968), 17.
7. Rao, G. K. & Malathi, M. A., *J. Fd. Sci. Tech.*, **6** (1969), 129.
8. Rao, G. K., Malathi, M. A. & Mohan, M. S., *J. Fd. Sci. Tech.*, **6** (1969), 279.
9. Kannur, S. B., Eapen, K. C., Rao, G. K., Vijayaraghavan, P. K. & Nath, H., *J. Fd. Sci. Tech.*, **9** (1972), 179.
10. Ghosh, K. G., Srivatsa, A. N., Nirmala, N & Sharma, T. R., *J. Fd. Sci. Tech.*, **10** (1973), 105.
11. Srivatsava, M. P., Nirmala, N. & Bhatia, B. S. *J. Fd. Sci. Tech.*, **10** (1973), 112.
12. Ghosh, K. G., Sharma, T. R. & Nath, H., *J. Pack.*, **5** (1973), 15.
13. Ghosh, K. G., Eapen, K. C., Sharma, T. R. & Nath, H., (CDSO, UK), (1973).
14. Ghosh, K. G., Sharma, T. R. & Nath, H., *Ind. Food Pack.*, **3** (1974), 11.
15. Srivatsava, M. P., Ghosh, K. G., Sharma, T. R. & Nath, H., *Ind. Food Pack.*, **1** (1974), 45.
16. Ghosh, K. G., Krishnappa, K. G., Eapen, K. C., Mattada, R. R., Sharma, T. R. & Nath, H., *J. Fd. Sci. Tech.*, **11** (1974), 125.
17. Ghosh; K. G., Krishnappa, K. G., Eapen, K. C., Sharma, T. R. & Nath, H., *J. Fd. Sci, Tech.*, **11** (1974), 101.
18. Srivatsa, A. N., Krishnappa, K. G., Sharma, T. R. & Nath, H., *J. Fd. Sci. Tech.*, **12** (1975), 64.
19. Ghosh, K. G., Nirmala, N., Ramakrishna, M. S., Srivatsa, A. N., Sharma, T. R. & Nath, H., *ISI Bulletin*, **28** (1976), 450.
20. Ghosh, K. G., Nirmala, N., Ramakrishna, M. S., Srivatsa, A. N., Sharma, T. R. & Nath, H., *ISI Bulletin.*, **28** (1976), 486.
21. Nirmala, N., Ghosh, K. G. & Sharma, T, R., *J. Fd. Sci. Tech.*, **13** (1976), 162.
22. Ghosh, K. G., *Packaging INDIA*, **8** (1976), 19.
23. Srinivasa Gopal, T. K., Parameswariah, P. M., Ghosh, K. G. & Sharma, T. R., *J. Fd. Sci. Tech.*, **14** (1977), 212.
24. Ghosh, K. G., Srivastava, M. P., Srivatsava, A. N. & Sharma, T. R., *J. Fd. Sci. Tech.*, **14** (1977), 66.
25. Nirmala, N., Krishnappa, K. G., Ghosh, K. G. & Sharma, T. R., *J. Fd. Sc. Tech.*, **14** (1977), 274.
26. Ghosh, K. G., Nirmala, N., Ramakrishna, M. S., Srivatsa, A. N., Sharma, T. R. & Nath, H., *ISI Bulletin*, **29** (1977), 274.
27. Ghosh. K. G., Srivatsa, A. N., Nirmala, N. & Sharma, T.R., *J. Fd. Sci. Tech.*, **14** (1977), 261.
28. Ghosh, K. G., Krishnappa, K. G., Srivatsa, A. N , Eapen, K. C. & Vijayaraghavan, P. K., *J. Fd. Sci.* Tech., **16** (1979), 198.
29. Ghosh, K. G., Krishnappa, K. G., Eapen, K. C. & Vijayaraghavan, P. K., *Res. and Ind.*, **25** (1980), 140.
30. Krishnappa, K. G., Srivatsa, A. N., Ghosh, K.G., Eapen, K.C. & Vijayaraghavan, P. K., *Indian Food Packer.*, (1982), 11.