IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
**Research Article**
January 2020 Vol.:14, Issue:3


# Testing the Stability of Material for Packaging of Dried Fruit

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

**Ajka Aljilji[1], Omer Mahmutović[2*]**

[1] *University of Prizren "Ukshin Hoti" Faculty of Education, Rruga e Shkronjave, nr. 1, 20000 Prizren, Kosovo*

[2] *University of Sarajevo, Faculty of Educational Sciences, Skenderija 72, Sarajevo, Bosnia and Herzegovina*

**Submission:** 23 December 2019
**Accepted:** 29 December 2019
**Published:** 30 January 2020

HUMAN JOURNALS

www.ijsrm.humanjournals.com

**Keywords:** packaging materials, polymers, thickness, dried fruit

**ABSTRACT**

Rational choice and the use of appropriate packaging materials influence the preservation of the qualitative characteristics of the product. One of the important features of the packaging material is its thickness. The thickness determines the protective properties of the packaging material, and the uniformity of thickness is important for the passage of material on the packaging machine and the correct formation of packaging units. Reducing the thickness, and therefore the mass per unit is achieved by using modern polymer materials. Reducing the thickness/mass is justified from an ecological and economic point of view. However, packaging material, especially made up of multiple layers of polymer, can reduce its thickness over time, which can lead to loss of function of the packaging. The quality control of five types of packaging material for dried fruits was examined by measuring of their thickness over time: Polyethylene (PE); Oriented polypropylene (OPP); Oriented polypropylene (OPP) / Polyethylene (PE); Polyester (PET) / oriented polypropylene (OPP) met / Polyethylene (PE); Oriented polypropylene metalized (OPPmet). The results of the experiment show that there are no significant deviations over time. The quality of the tested material was satisfactory except for (PET/OPPmet/PE) 12/38/50 µm, so it is not recommended for use in dry fruit packaging technology.

## INTRODUCTION

The packaging is about protecting the product until it is used. Together with the product, the packaging forms a unique whole that is presented to the customer, which means that it is an integral part, protects and presents of product, thus providing the necessary information about the content. The task of the packaging is to protect the product from mechanical, physical, chemical, microbiological and biological changes caused by the action of the external environment and storage time, in all conditions of packaging and storage [1]. The quality of the packaging unit formation means that all ports on the primary packaging are well closed, which makes the storage of the contents sustainable and of good quality. One of the important features of the packaging material is its thickness. The thickness determines the physical-mechanical as well as the protective properties of the packaging material, and the uniformity of thickness is important for the passage of material on the packaging machine and the correct formation of packaging units. Reducing the thickness, and therefore the mass per unit is achieved by using modern polymer materials [2]. In this way, we get better quality packaging material, which is justified from an ecological and economic point of view.

## PACKAGING MATERIALS

Polyethylene has good thermal properties. It is used in the structure of multilayer materials, as a layer that makes it easy to form packaging units on packaging machines. Due to its good chemical properties, it is used as a layer that is in direct contact with the packaged product. It is combined with polyester, polypropylene and other packaging materials [1].

Polypropylene is one of the lightest polymers. The specific mass is within the values of 0.90g/cm$^3$- 0.91 g/cm$^{3.}$ The polyethylene used for the packaging of dehydrated products in the form of foils, usually in combination with other mono materials is produced under high pressure (1215bar), has a density of 0.92 - 0.94g/mm$^3$. In dehydrated products, it forms an outer layer of combined packaging materials [3].

Polyester is produced in a crystalline and amorphous state with melting points of about 260˚C. Polyester foils are characterized by less water vapor permeability than other plastic foils. Due to its low light transmittance, good mechanical, physical and chemical properties, polyester plays a large role in food packaging. In combination, polyester provides good protection and strength to the packaging material, while polypropylene and polyethylene give the weld-ability. These multilayer packaging materials are used for better food storage results. Which combination will be used depends on the type of content that is packing [4].

Metalized foils are polymeric films coated with a thin layer of metal, mostly aluminum. This combined multilayer packaging material contributes to aesthetics and usually carries the product declaration, which is significant as a marketing function [5].

The drying process is a process of lowering the water content in the substrate and water that is necessary for the growth of microorganisms that cause food spoilage, thus achieving a food preservation process. By drying, we get a finished product, which after rehydration could again obtain the original form, becomes suitable for immediate consumption with the optimal presentation of the original energy-nutritional properties [6].

## PACKAGING PROCESS

Technological process of production of dried fruit [7]:

1. Calibration
2. Cleaning
3. Washing
4. Cutting
5. Treatment with sulfur dioxide
6. Drying
7. Packing.



One of the important properties of packaging materials is its thickness. Thickness determines the physic - mechanical properties of the packaging material. The uniformity of thickness is essential for materials and their mobility, packaging, and correctness when forming packing units. Packaging made up of multiple layers of the polymer can reduce its thickness over time, which can lead to loss of function of the packaging - penetration of external influences [8]. Checking the thickness of the packaging material over time is important as a measure of the quality of the packaging [2,9]. In this paper, thickness stability testing was performed, for five types of plastics (single and combined) used as packaging material. The packed contents were dried fruits.

## MATERIALS AND METHODS

### Drying and packaging

The industrial mini drier Iverak (Iverak, Valjevo, Serbia), used for drying fruits, vegetables, forest fruits, mushrooms, and medicinal herbs, has a drying capacity of 1000-1300kg. The drying temperature depends on the product and ranges from $50^0$C to $80^0$C. The temperature in the tunnel is controlled by automatic thermoregulation. The two-way fan ensures the uniqueness of the air distribution in the tunnel. The fan is programmed using the system on the control panel. The dryer is made of solid material. The tunnel of the dryer is built of polyurethane. The dimensions of the tunnel are length 5.1 m, width 2m, height 2m. Air circulation is determined by the fan installed on the upper side of the dryer.

A sample of various apple varieties was used for drying, totally about 100 kg. The mixed fruit sample was previously washed and cut into pieces in the same size and shape (calibrated). Prepared fruit was dried at a temperature of max 65 ° C for 15-18 hours. 100 g of dried fruit was packaged unit in tested packing material. After filling, the contents were closed with a laboratory closing machine. The samples of fruit, informed bags, were stored under normal conditions, at room temperature of 17-22 ° C for six months, exposed to the influence of light.

## MATERIALS AND TESTING

Tested materials were made of individual and combined packaging materials. The packaging unit made of combined materials is formed by a heat seal [10]. The testing of the thickness of the packaging material was carried out according to the following dynamics: 0, 30, 60, 120,180 days. The results are given as an average of measurements taken on five samples. The sample thickness is measured by the method according to JUS UG. S2.733 [11] with precision electronic thickness tester (Extech, USA). Measurements were made at eight positions on each sample. Thickness measurement was done by placing a foil in the instrument, after releasing the handle the upper tapping acts by constantly pressing the tile and on the scale it is possible to read how much foil is thickness - in microns.

Five types of packaging material were used in this research. Packaging units are made of the following materials:

1. Monomaterial, polyethylene (PE) of thickness 95 µm.

2. Monomaterial, oriented polypropylene (OPP) thickness of 20 µm.

3. Combined packaging material, oriented polypropylene (OPP) / Polyethylene (PE) thickness 20/50 µm.

4. Monomaterial, Oriented metalized polypropylene (OPPmet) thickness of 20µm.

5. Combined packaging materials, Polyester (PET) / oriented polypropylene (OPP) met / Polyethylene (PE) 12/38/30 µm.

## RESULTS AND DISCUSSION

The results of the thickness of the packaging material PE (95) µm are shown in table 1.

**Table No. 1: The thickness of the packaging material PE (95) µm**

| Position | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 30 | 60 | 120 | 180 |
| 1 | 91 | 90 | 95 | 90 | 94 |
| 2 | 92 | 91 | 95 | 91 | 92 |
| 3 | 95 | 91 | 92 | 90 | 90 |
| 4 | 95 | 91 | 91 | 92 | 91 |
| 5 | 97 | 95 | 91 | 95 | 91 |
| 6 | 92 | 96 | 91 | 95 | 98 |
| 7 | 97 | 98 | 92 | 92 | 93 |
| 8 | 93 | 95 | 91 | 93 | 97 |
| X | 94.0 | 93.7 | 92.2 | 92.2 | 93.2 |
| S | 2.179 | 2.915 | 1.641 | 1.856 | 2.728 |
| S(x) | 0.819 | | | | |

The thickness of the packaging material ranged from 90 to 98 µm. The mean value of the tested samples ranged 92.2 - 94.0 µm and a standard deviation of mean values were 0.819. The results obtained indicate that the packaging material PE has a very good uniformity of the thickness. The results indicate a good technological process of material production. The uniqueness of the thickness provides a good quality of the packaging material and the quality formation of packaging units.

The results of the thickness of the packaging material OPP (20) are shown in table 2.

**Table No. 2: The thickness of the packaging material OPP (20) µm**

| Position | Days | | | | |
|---|---|---|---|---|---|
| | **0** | **30** | **60** | **120** | **180** |
| **1** | 20 | 20 | 19 | 20 | 20 |
| **2** | 21 | 20 | 20 | 20 | 20 |
| **3** | 20 | 20 | 20 | 21 | 20 |
| **4** | 20 | 19 | 20 | 20 | 21 |
| **5** | 20 | 20 | 21 | 20 | 21 |
| **6** | 20 | 19 | 19 | 20 | 21 |
| **7** | 20 | 20 | 19 | 21 | 21 |
| **8** | 20 | 20 | 19 | 21 | 21 |
| **X** | 20.1 | 19.8 | 19.6 | 20.4 | 20.6 |
| **S** | 0.354 | 0.463 | 0.744 | 0.518 | 0.518 |
| **S(x)** | 0.418 | | | | |

The thickness of the packaging material ranged from 19 to 21 µm. The mean value of the tested samples ranged from 19.6 - 20.6 µm and a standard deviation of mean values were 0.418. OPP packaging material has a uniform thickness. The thickness of the material allows the quality formation of packaging units.

The results of the tests the thickness of the packaging material OPP met /PE (20/50) are shown in table 3.

**Table No. 3: The thickness of the packaging material OPP met / PE (20/50)µm.**

| Position | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 30 | 60 | 120 | 180 |
| **1** | 69 | 69 | 71 | 71 | 70 |
| **2** | 70 | 70 | 71 | 71 | 70 |
| **3** | 65 | 72 | 70 | 71 | 71 |
| **4** | 62 | 71 | 72 | 70 | 73 |
| **5** | 63 | 72 | 69 | 70 | 71 |
| **6** | 66 | 73 | 71 | 70 | 72 |
| **7** | 69 | 69 | 70 | 70 | 70 |
| **8** | 72 | 75 | 66 | 70 | 70 |
| **X** | 67.0 | 71.4 | 70.0 | 70.4 | 70.9 |
| **S** | 3.546 | 2.066 | 1.852 | 0.518 | 1.126 |
| **S(x)** | 1.715 | | | | |

The thickness of the packaging material ranged from 62 to73 µm. The mean value of the tested samples ranged 67.0 - 71.4 µm and a standard deviation of mean values were 1.715. The values obtained indicate a small deviation of thickness OPP met / PE packaging materials. This small deviation results can be explained by the uneven distribution of the adhesive at combined OPP met and PE materials.

The results of the thickness of the packaging material OPP met (20) are shown in table 4.

**Table No. 4: The thickness of the packaging material OPP met (20) µm**

| Position | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 30 | 60 | 120 | 180 |
| **1** | 19 | 19 | 20 | 20 | 20 |
| **2** | 19 | 19 | 20 | 20 | 21 |
| **3** | 19 | 19 | 20 | 21 | 20 |
| **4** | 19 | 20 | 20 | 21 | 20 |
| **5** | 19 | 20 | 20 | 20 | 19 |
| **6** | 19 | 20 | 20 | 20 | 20 |
| **7** | 20 | 21 | 21 | 21 | 21 |
| **8** | 20 | 20 | 20 | 21 | 20 |
| **X** | 19.3 | 19.8 | 20.1 | 20.5 | 20.1 |
| **S** | 0.463 | 0.707 | 0.354 | 0.535 | 0.641 |
| **S(x)** | 0.473 | | | | |

The thickness of the packaging material ranged from 19 to 21 µm. The mean value of the tested samples ranged from 19.3 - 20.5 µm and a standard deviation of mean values were 0.473. The values obtained indicate a slight deviation of the thickness of OPP metal packaging materials. This small deviation does not create a problem with the good quality formation of packaging units. The results also point to a good technological process of material production.

The results of the thickness testing of packaging materials 12/38/50 (PET / OPP met / PE) are shown in table 5.

**Table No. 5: The thickness of the packaging material 12/38/50 (PET / OPP met / PE) µm**

| Position | Days | | | | |
|---|---|---|---|---|---|
| | **0** | **30** | **60** | **120** | **180** |
| **1** | 78 | 78 | 79 | 79 | 78 |
| **2** | 78 | 79 | 79 | 80 | 78 |
| **3** | 79 | 80 | 80 | 78 | 80 |
| **4** | 79 | 79 | 78 | 78 | 80 |
| **5** | 79 | 79 | 79 | 81 | 79 |
| **6** | 78 | 79 | 77 | 80 | 79 |
| **7** | 79 | 80 | 79 | 79 | 80 |
| **8** | 79 | 79 | 79 | 80 | 79 |
| **X** | 78.6 | 79.1 | 78.8 | 79.4 | 79.1 |
| **S** | 0.518 | 0.641 | 0.886 | 1.061 | 0.835 |
| **S(x)** | 0.306 | | | | |

The thickness of the packaging material ranged from 77 to 81 µm. The mean value of the tested samples ranged 78.6 – 79.4 µm and a standard deviation of mean values were 0.306. After the expiration of 120 days, the emergence of mildew was evident in the material 12/38/50 (PET / OPP met / PE) µm. This combination showed a very stable thickness, but apparently, the layers were not well melted, there were spots of air passage that contaminated the contents of the package. This suggests that this type of packaging is not suitable for packaging dried fruit.

## CONCLUSION

The results of the test for all five types of packaging materials showed well stability of the thickness over time. The results of the experiment show that there are no significant deviations from the nominal values of these materials. Minor deviations from the declared values of the monomaterial from the combination indicate the good formation of packaging units. Only a uniform application of the adhesive is required. After the expiration of 120 days, the emergence of mildew was evident in the material PET / OPP met / PE (12/38/50µm). There have not been any changes in other packaging materials (PE 95µm; OPP 20µm; OPP / PE 20/50µm; OPPmet 20µm) and that all four can be used as the appropriate material for the packaging of dry fruit.

The quality of all tested material was satisfactory except for (PET / OPP met / PE) 12/38/50 µm, so it is not recommended for use in dry fruit packaging technology.

## REFERENCES

[1] Lefaux R. Plastic materials in the industry. Paris; 1972.
[2] Curaković M, Vujković I, Gvozdenović J. Control of packaging materials. Faculty of Technology. Novi Sad; 1992.
[3] Gvozdenović J, Curaković M, Lazić V. Change of Nutritive Value of Powdered Garlic During Storage. 16. Int. Congress of Nutrition. Montreal Canada. 1997.
[4] Vujic D, Bardi B. Manual quality control of raw materials and products of fruit. Faculty of Technology. Novi Sad; 1975.
[5] Đorđević V. Contemporary packaging - Production and application of metalized foils. Savropak Beograd; 1995.
[6] Labuza TP. Effects of dehydration and storage. Food Technology. 1973;27:20-26
[7] Nijhuis H. Toriga H. Yuksel C. Approaches to improving the quality of dried fruit and vegetables. Technology. 1998;9:13-20.
[8] Gvozdenović J, Curaković M, Lazić M. Stability of nutritive characteristics of packed tomato powder. European Nutrition Conference. Lillehammer Norway. 1999.
[9] Gvozdenović J, Aljilji A, Svrzić G, Tepić A, LazicV. Influence of protective characteristics of packaging materials on packed dried fruits. 2nd Int. Congress on bioprocesses in food industries. Patras Greece. 2006.
[10] Rapajić B. Processing of plastic mass by extrusion. Economic review (Privredni pregled). 1976;1-50
[11] JUS (SPRS) standard. Plastics - determination of film thickness. Official Gazette 2/68. 1972.