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Preliminary Study on Polymeric Films for Food Packaging

[1]M. Ikusedun, [2]H.B. Bello, [3]M.O. Adeosun, [4]O.E. Olodu, [5]O.O. Luji, [6]J. Obe, [7]S.A. Ajani

1,4,5,6,7 Federal Institute of Industrial Research Oshodi
2, Ogun Rural Access and Agricultural Marketing Project.
3 Ogun Rural Access and Agricultural Marketing Project.

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Corresponding Author
Ikusedun, Mojibayo
E-mail: *omoikusedun03@gmail.com*
Phone: *+2347087539716*

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ABSTRACT

The properties of packaging materials have been investigated and have been found to have effects on packaged foods either positively or negatively, hence the need for appropriate packaging materials for food products. This study investigated the barrier properties (permeability values) of food packaging materials as they affect the stability of packaged food products. The focus of this study was on two different packaging materials, namely Low Density Polyethylene (LDPE) and Polyethylene Terephthalate (PET) films and how their barrier properties affect the stability of packaged foods, particularly, the dried grinded pepper selected for this study. The barrier properties of the two selected packaging materials were investigated through direct method of shelf life study. The selected packaging materials of 0.08mm thickness each were developed into pouches of equal sizes and shapes with length 50cm and breadth 30cm each. 50g of the dried grinded pepper (Piripiri) was packaged with the pouches made with low density polyethylene and polyethylene terephthalate films. Proximate and microbial analyses of the dried grinded pepper were carried out before packaging. Post packaging analyses were also carried out after 180days of storage and results of the analyses were recorded. Parameters such as moisture content, ash content, crude fibre , crude protein and carbohydrate were investigated using AOAC method. Elemental analysis was done using energy dispensive x-ray flourensce (EDXRF) method.

INTRODUCTION

Packaging, to a lay man, is just an ordinary containment, a wrapper, a glass bottle or a metal can, but packaging engineers and scientists consider packaging to be a coordinated system of preparing goods for transport, distribution, storage, retailing and end-use (IoPP, 2009). It is also an essential tool in product protection and preservation. Food packaging is a system designed for the efficient delivery of high quality, safe food products throughout every phase of the supply chain, from raw materials production to food manufacture, packing, retail, wholesale, consumer use, disposal, and recycling or other means of resource recovery.

However, for Engineers, Scientist and technologists to get expected result from packaging, packaging selection has to be carefully made, considering the fact that packaging is required to extend shelf life of food, enhance safety, quality and convenience for end users. (Dun Sun Lee, 2008).

Properties of packaging materials play vital roles in ensuring the stability of food and reduction in food deterioration. Research findings have shown that properties of materials used in packaging could have effects on the packaged products such as food and non-food products. The performances of food packaging materials are very important for the stability of food products. It is very imperative to put into consideration the physical, mechanical, chemical and barrier properties of packaging materials.

It is also important to consider different functions of packaging such as protection, convenience and containment. The first function is to protect the food from physical damage, microbial spoilage and physiochemical deterioration because if the package does not provide protection for the packaged food, there could be loss of nutrients, flavour, aroma, colour, texture and the food may be unsafe for consumption. Packaging must provide protection against moisture and oxygen which are key factors contributing to food spoilage. The protection against moisture and oxygen is important to achieving anticipated shelf life of food. Packaging must provide convenience without compromising the safety of packaged foods.

MATERIAL AND METHODS

Fresh pepper also known as Piripiri was collected from a local farm in Ofada, Obafemi Owode Local Government, Ogun State, Nigeria. The pepper was dried and grinded. 50g of the dried, grinded pepper was packaged with pouches made with low density polyethylene films and another 50g of the dried, grinded pepper was also packaged with pouches made with polyethylene terephthalate films. The pre-packaging analysis of the dried, grinded pepper was carried out. The proximate and microbial analyses of the packaged of the dried, grinded pepper were done before packaging and after 180 days of storage in standardized conditions and results were recorded.

Table 1. Permeability values of the selected films.

Polymer	Oxygen Permeability	Carbon dioxide Permeability	Water vapours Permeability
Low Density Polyethylene	300-600	1200-3000	1-2
Polyethylene Terephthalate	3-6	1200-3000	1-2

(Unit in (g.mil)/(100 in 2 day) at 38^0c, 90%RH.)
Source: Food Packaging Science and Technology (Dun Sun Lee, 2008)

Table 2. Proximate and Elemental analyses results of the grinded pepper.

Analysis performed		Result	
Proximate Analysis		Dried Grinded Pepper	TEST METHOD
Moisture	% w/w	5.35±0.10	AOAC
Ash	% w/w	6.86±0.17	AOAC
Ether Extract	% w/w	18.12±0.07	AOAC
Protein	% w/w	13.08±0.14	AOAC
Crude Fibre		23.30±0.17	AOAC
Total Carbohydrate (by difference)		33.29	NA
Magnesium	mg/kg	247.08	AOAC
Calcium	mg/kg	5284.69	AOAC
Maganese	mg/kg	247.08	AOAC

Table 3. Microbiological analysis results before packaging.

SAMPLE	0 DAY			
	Fungi count x10 ^{2} Cfu/g	Coliform count x10 ^{2} Cfu/g	Salmonella shigella count x10 ^{2} Cfu/g	Staph Count x 10 ^{2} Cfu/g
DGP/PET	3	ND	ND	5
DGP/LDPE	3	ND	ND	5

Table 4. Microbiological analysis results of the dried grinded pepper packaged with polyethylene terephthalate film for 180days of storage.

SAMPLE	180 days of storage.			
	Fungi count x10 ^{2} Cfu/g	Coliform count x10 ^{2} Cfu/g	Salmonella shigella count x10 ^{2} Cfu/g	Staph countx 10 ^{2} Cfu/g
DGP/PET	4	ND	ND	7

Table 5. Microbiological analysis results of the dried grinded pepper packaged with low density polyethylene film for 180days of storage.

SAMPLE	180 days of storage.			
	Fungi count x10 ^{2} Cfu/g	Coliform count x10 ^{2} Cfu/g	Salmonella shigella count x10 ^{2} Cfu/g	Staph count x 10 ^{2} Cfu/g
DGP/LDPE	5	ND	ND	8

Note on Abbreviation:-%w/w-Percentage weight per weight, cfu/g-Colony forming unit per gram, mg/kg-Milligram per kilogram, ND-Not detected, AOAC- Association Official Analytical Chemists.
DGP/PET – Dried Grinded Pepper Packaged With Polyethylene Terephthalate Pouches
DGP/LDPE– Dried Grinded Pepper Packaged With Low Density Polyethylene Pouches.

RESULTS AND DISCUSSION

Most foods are sensitive to moisture and oxygen which are both key factors in food spoilage because the ingress of moisture and oxygen contribute to the propagation of microorganisms such as fungi, staphylococcus, ecoli, salmonella shigella etc. It is very important to consider the permeability values of packaging materials in material selection since barrier protection against oxygen and water vapour are key to food stability. Permeability describes the level at which a packaging material provides barrier to the passage of permeates such as oxygen and water vapour. The ingress of oxygen and moisture could cause loss of colour, flavour, aroma and loss of other nutritional values and could also cause microbial spoilage. Table 1 showed that the selected packaging materials have barrier properties which are indirectly proportional to the permeability values of the selected packaging materials i.e the higher the permeability value the lower the barrier to moisture, oxygen, carbon dioxide etc. Low density polyethylene possessed permeability values for oxygen, carbon dioxide and water vapour higher than that of polyethylene terephthalate as presented in

Table 1 . Table 2 presented the proximate and elemental values of the dried grinded pepper. Table 3, 4 and 5 presented the microbiological values. Fungi counts and staphylococcus counts were found to be 3 x10 ^{2} $_{Cfu/g}$ and 5 x10 ^{2} $_{Cfu/g}$ respectively in the dried grinded pepper before packaging while coliforrn and salmonella shigella were not detected as shown in Table 3. After 180days of storage, table 4 showed that fungi counts and staphylococcus counts in the dried grinded pepper packaged with polyethylene terephthalate increased slightly to 4 x10 ^{2} $_{Cfu/g}$ and 6 x10^{2} $_{Cfu/g}$ respectively which showed little permeability and high barrier to moisture and oxygen, coliform and salmonella shegella were not also detected. As shown in table 5, fungi counts and staphylococcus counts of the dried grinded pepper packaged with low density polyethylene were found to be 5 x10 ^{2} $_{Cfu/g}$ and 8 x10 ^{2} $_{Cfu/g}$ respectively, with increase from 3 x10 ^{2} $_{Cfu/g}$ and 5 x10 ^{2} $_{Cfu/g}$ which were the initial microbial loads, the values were higher than that of dried grinded pepper packaged with polyethylene terephthalate which means that low density polyethylene possesses higher permeability and low barrier property than polyethylene terephthalate. The increase in the microbial load of the food sample packaged with low density polyethylene indicated the evidence of the ingress of oxygen and increase moisture which contributed to the increase in microbial loads as shown above.

CONCLUSION

Food science is important to understanding the deterioration kinetics and stability of foods. The deterioration kinetics such as microbial growth, lipid oxidation, moisture gain or loss which govern the shelf life of foods have to be well examined and understood. Deterioration kinetics involve the understanding of food packaging science which also involves the principles from two areas of science which include food science and material science to understand the properties of packaging materials, the packaging requirement of foods and the packaging systems. The results above have shown that packaging films possess different barrier properties and so properties of packaging materials to be used for packaging have to be investigated in order to know which packaging material is best suitable for a particular food product.

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