

Overall Migration of the High Density Polyethylene in Bags used for carrying Hot Breads in the Traditional Bakeries

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Abstract

The main objective of this study to identify the effects of the temperature for the high density polyethylene (HDPE) used for carrying hot breads in the traditional bakeries (17 bakeries). From the results of the experimental analysis we found plastic components migration from the three types of the HDPE in the both simulants, distilled water and 3% of Acetic acid, at 70°C and 100°C of temperature. The obtained results concerning types A, B and C plastic bags in the distilled water simulant at 70°C were 0.40, 0.90 and 2.60, thus at 100°C were 0.60, 1.10 and 2.90 respectively. On the other hand, the obtained data for 3% of acetic acid at 70°C were 0.80, 29.90 and 59.20, also at 100°C were 0.90, 54.60 and 116 respectively. If we compared the obtained results between the two simulants we could mention that, there is significant relationship. We could confirm that there are significant relationships between the distilled water simulant and the 3% of Acetic acid simulant at both temperatures (70 and 100 °C). The big deferent between A, B and C bags in the 3% of acetic acid concern the color of the bags.

Keywords: temperature, high density polyethylene, migration, plastic bags, stimulant,

1. INTRODUCTION

The plastic packaging materials are the most materials used in the food packaging, in this days especially in the world of the fast food, it is played important role because it is suitable for many purposes in our daily life for home uses, There are various types of packaging material including paper, board, plastic, metal, glass, wood and other materials. Paper and board packaging accounted for the largest share of global packaging sales in

2003 with 39% of the total. Plastic packaging accounted for 30% (rigid and flexible plastics) of the market, with metal packaging accounting for 18% and glass packaging a further 7%. Other packaging products accounted for the remaining 6% of the market. Rigid plastics were the fastest growing sector of the market during the period 1999-2003. Around 70% of overall consumer packaging consumption is used for food and beverage packaging [1]. Many different types of plastics are being used as packaging materials. The key components in plastic materials are polymers which are made of units of organic material, and one or more of large molecular weight can be formed as desired. Most polymers are petrochemical compounds with additive materials to give them properties of flexibility, elasticity and resistance to fracture and transparency to light [2, 3]. The final plastic material thus is a mix of polymer, additives, manufacturing aids, and side products from the complex polymerization process that were not intentionally added [4]. Low density Polyethylene (LDPE) is used in preparation of most of the hot food packaging. LDPE has high flexibility, and can be affected by organic solvents. It has melting temperature of 110 C [5]. Recently appear many rumors about the expected hazards of using plastic bags for carrying the hot food. Plastic bags cause a significant amount of global environmental damage. Because they are so abundant, plastic bags are quickly discarded and only 3% are recycled. The 500 billion to 1 trillion plastic bags that end up as trash every year devastate fragile ecosystems and take around a thousand years to decompose. In the 1980, plastic trash was estimated to have killed over 100,000 marine mammals and sea turtles annually [6].

While plastic bags are doing a great deal of damage, it is possible for the average person to make a difference. People must first become informed about environmental problems associated with plastic bags, then spring to action by using reusable shopping bags, bringing their own plastic bags to designated recycling venues (at grocery stores, etc...) and pushing for laws that ban plastic bags from stores all together.

Our study has as objective to identify overall Migration Test for the High Density Polyethylene Bags used for carrying Hot Breads in the Traditional Bakeries, Alsatwa Area, Dubai, UAE, (2015)

2. EXPERIMENTAL

2.1. Area of study

The study was conducted in ALSATWA area in Dubai (UAE) (map fig. 1). The number of estimated population 69.607 person [7].



Fig.1. Map of Area of study : SATWA and ALBADA – Dubai, UAE

2.2. Methodology

2.2.1. Study Design

This research work is an experimental design study concerning the small traditional industry in particular the traditional bakery. Three samples (fig.2) had been collected by random simple sampling and all the bakeries numbered and the selection happens by pumpkin (17%). The work was conducted as experimental design study by Alhoty Stanger laboratory.



Fig. 2: The hot breads in the plastic bags (3 samples)

2.2.2. Chemicals Analysis

Three samples from the high density polyethylene plastic bags (A, B and C) had been given to the laboratory (Alhoty Stanger Laboratory). The lab divide each sample to two samples, the first one is fixed in the distilled water for two hours and the second one in 3% of Acetic acid also for two hours in deferent temperatures degree 70°C and 100°C in calibrated oven, and also using calibrate decimal for weight balance, this operation was done for the three types (A, B and C). The selection of the condition of test and the food simulants shall be determined by the condition of use test specimens (of approximately 10 cm ×10cm) are immersed in the food stimulant for the exposure time at temperature up to and including the temperature of reflux. At the end of the test period, each test specimen is removed from the food simulant. The food simulant from each test specimen is evaporated to dryness, the mass of the non-volatile residue is determined gravimetrically and expressed as milligrams per square decimeter of surface area of test specimen. The collected data were processed and analyzed by using Statistical Package for Social Sciences (SPSS).

2.3. Materials



Fig.3: Hot breads temperature (over 80°C)

3. RESULT AND DISCUSSION

Substances that may migrate from polyethylene plastics to foodstuffs include residual monomers, low-molecular-weight polymers (oligomers), and any additives or other substances used in the formulations or the manufacturing process. The present study revealed overall migration test for the high density polyethylene Bags used for carrying hot breads in the traditional bakeries, Alsatwa Area, Dubai, UAE, (2015), Lab result showing in the appendix.

3.1. Results of the chemical analysis

The limit contained in Directive 2002/72/EC is specified as 10 milligrams of plastics substances released per square decimeter of plastic surface area (mg/dm^2) or, alternatively, 60 milligrams of plastics substances transferring to 1 kilogram of foodstuff (mg/kg). Ethylene, the principal monomer used to manufacture polyethylene. The overall migration of the High density polyethelene in mg/dm^2 of the 3 plastic bages tested for 2 hours agianst distilled water and 3% of acetic acid at 70 and 100 °C are mentioned in figur 4, 5 and Table 1.

Table 2. The overall migration of the High density polyethylene in mg/dm^2 of the 3 plastic bags against distilled water and 3% of acetic acid at 70 and 100 °C

High density polyethylene in mg/dm^2	Distilled water For 2h		3% of Acetic Acid For 2h	
	70 °C	100 °C	70 °C	100 °C
Plastic bags replicates				
Bag A				
R1	0.40	0.60	0.60	0.80
R2	0.40	0.50	0.90	0.70
R3	0.40	0.70	0.90	0.90
Mean .Type A	0.40 c	0.60 c	0.80 c	0.90 c
Bag B				
R1	0.90	1.00	29.85	54.50
R2	0.80	1.00	29.88	54.60
R3	1.00	1.30	29.98	54.60
Mean. Type B	0.90 b		1.10 b	29.90 b 54.60 b
Bag C				
R1	2.55		2.80	59.40 115
R2	2.55		3.10	59.00 116
R3	2.70		2.80	59.20 117
Mean .Type C	2.60 a		2.90 a	59.20 a 116 a
Mean	1.3		1.5333	29.9666 57.1666
L.S.D at $P \leq 5$	0.19138		0.38275	0.39522 1.45628

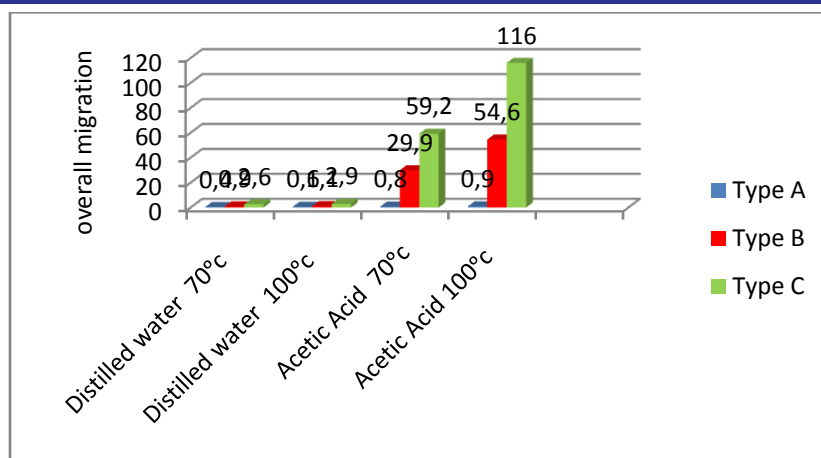


Fig. 4: The overall migration of the High density polyethylene in mg/dm² of the 3 plastic bags against distilled water and 3% of acetic acid at 70 and 100 °C

From the analytical results if we are comparing between the distilled water simulant and the 3% of acetic acid simulant in high density polyethelen plastic bag type A, there is no significant relationship between the temperature degree 70°C and 100°C, regarding the results 0.40 at 70°C and 0.60 at 100°C for the distilled water. Thus, 0.80 and 0.90 at 70 and 100°C respectively for the 3% of Acetic acid, all these results were below the standard limits recommended by the Western Union (10mg / dm²).

The obtained results for the plastic bags type B high density polyethylene showed that, there is no significant difference between the distilled water simulant according to temperature, 0.90 at 70°C and 1.10 at 100°C. These results were below the standard limits recommended by Western Union limit. Also the obtained data showed that, there is no significant relationship between the 3% of Acetic acid simulant at the deferent temperatures 70°C and 100°C with 29.90 and 54.60 respectively. But these results are over the standard limits recommended by the Western Union which is 10mg / dm².

Concerning the plastic bags type C high density polyethylene, the obtained results are 2.60 and 2.90 at 70°C and 100°C respectively explained that there is no significant relationship between the distilled water simulant according to temperature, which are below the standard limits recommended by Western Union limit. Regarding the 3% of Acetic acid stimulant, the obtained results illustrated that at temperatures 70°C and 100°C, we got 59.20 and 116 respectively, which means; there is no significant relationship between the tested parameters. But the values obtained are over of the standard limits suggested by the Western Union.

From all these results for the three types of the high density polyethylene plastic bags, we found that, the obtained data for the distilled water simulants for type A, B and C were below the standards limits recommended by the western union limits, but there is a small significant relationship between these types at the different temperatures ranges (70 and 100 °C).

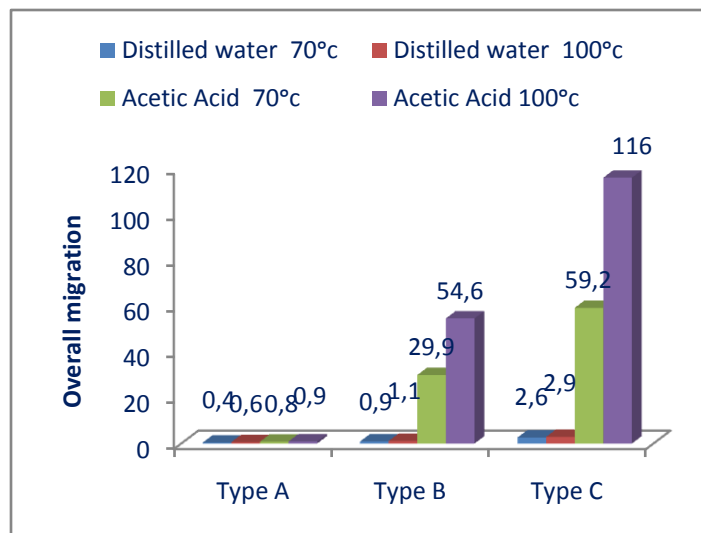


Fig. 5: The overall migration of the High density polyethylene in mg/dm² of the 3 plastic bags against distilled water and 3% of acetic acid at 70 and 100°C

3.2. Discussion

From the results of the experimental analysis we found plastic components migration from the three types of the High density polyethylene in the both simulants, distilled water and 3% of Acetic acid at different temperatures (70 and 100 °C), especially for the distilled water, but in this simulant under the limit of the western union (below 10mg/dm²), this result was agree with previous study in India about migration aspects for food contact materials with aqueous food simulating solvents as per different international standards [8], investigations on overall migration of various plastic materials and articles used in contact with foodstuffs, Packaging Technology and Science, John Wiley [9] and study conducted in Saudi Arabia in Contamination of Foods by Migration of Some Elements from Plastics Packaging [10]. If we are comparing this result with the Tolerable Daily Intake for the individual for long time may be it became a health problem, in this case we need to looking for alternative materials instead of the high density polyethylene plastic bags like food grade paper, and also we need to issue a new legislation like panning using of this bags for carrying hot breads and also making strong restrictions for the local and importer food packaging materials companies. Regarding to the results of the analysis in the 3% of Acetic Acid stimulant (Acidic food) as we are mentioned in the analysis the migration of the components from the high density polyethylene plastic bags more than the western union limit, although the hot breads it is neutral and till now we did not found acidic food holding at these temperature (70 and 100°C), but we need more researches in the future for different temperatures like chilling and freezing temperatures.

4. CONCLUSION

The study provide valuable analysis for Migration test for the High Density Polyethylene Bags used for carrying Hot Breads in the Traditional Bakeries, Alsatwa Area, Dubai, UAE, (2015). The investigation showed that the three types of the high density polyethylene plastic bags, we found also that, the obtained figures for the

distilled water simulants for type (A, B and C) were below the standards limits recommended by the western union limits, but there was a small significant relationship between these types at the different temperatures ranges (70 and 100°C). Thus, the results showed for 3% of Acetic Acid simulant (Acidic food) components migrate from the high density polyethylene plastic bags above the standards of western union limit ,although the hot breads it is neutral and till now we did not found acidic food holding at these temperature (70 and 100°C). The major recommendation obtained from this study was to find new legislations like banning using of these bags for carrying hot breads applied by the Dubai municipality, food safety department.

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