



The impact of plastic coat on food products and human health: A review

Afrah Hasan Ali ¹  , Salah Abd Al Mahdi Al Janah ² , Marwah Mohammed Hanaf ¹ 

¹College of Agriculture, Al-Muthanna University, Iraq

² College of Agriculture, University of Kufa, Iraq

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(✉) Corresponding Author: afrah.hasan@mu.edu.iq

Abstract

Plastic has been an important part of our lives for the past decades, as the basic material for many different commodities. The wide use of plastics has significantly impacted many products, especially nutritional ones. Plastic components affect many foods to varying degrees, it depends on the nature of the packaged food, the length of the storage period, and the method of preservation. The high temperatures significantly impacted the migration of many of the compounds present in the plastic coats to the food coat and from there to the consumer, a bad health impact on the consumer. Many researchers and scientists have stressed the need to find suitable alternatives for the manufacture of food coats, these materials were the use of materials derived from non-petroleum polymers, which can decompose and avoid environmental pollution, in addition to not affecting the consumer.

Keywords: Plastic, Food Coat, Plastic Coat Alternatives, Biodegradable Materials.

Introduction

Plastic is one of the common materials in the manufacture of all kinds of covers, especially food coat as the main material for coat various commodities and foodstuffs, there are a lot of health effects of these coats, especially food coat, therefore, attention has increased to reduce the use of these covers, finding a suitable alternative for it with a positive return on the consumer first and the producer second, as a result of the increased demand for ready-to-eat foods, which found popularity and a wide range and the reason for the increase in demand is the wide development in the methods of industry and food coat, preserves the shape and flavor of food for as long as possible, in addition to the fact that ready-to-cook food products are susceptible to oxidation (Akcan et al., 2016), due to the development in food coat, occupied a research area, so modern methods took a wide range in the coat operations, especially in the use of biodegradable coat to reduce waste (Del et al., 2017).

Plastic is the common name for polymer which are synthetic large molecular weight materials, it can be made from long chains and its main component is carbon and other elements, as they are chemicals produced from crude oil and gases whose composition is carbon, other chemicals may be added to the plastic during its manufacturing process, such as dyes,

solvents and lubricants, their purpose is to reduce the cost of manufacturing and plasticizing long chain polymers, each polymer consists of a monomer, they are linked together by chemical bonds, because of the different compositions of monomers, led to the production of polymers with different characteristics and properties. Plastic polymers have seven groups, and each group has specific properties that can be used in coat, when designing plastic in food coat, must take into account the type of food, temperature and contact time. The consumer must not misuse the coat materials and not re-use them, it is dangerous as a result of the transfer of chemicals to food (Al-Halfi, 2010).

Plastic industry and uses

Plastics are formed from the gas (monimer) after which it turns into a liquid, it is formed by heat or pressure and heat until it becomes solid in the final form, composite materials are sometimes formed, it is the addition of other materials to strengthen plastics, or other materials are added during manufacturing such as dyes, solvents and fillers, the purpose is to improve its resistance to heat and shock, gaining desirable characteristics among consumers, metals are often replaced by plastics due to their light weight, resistance to chemical corrosion, and electrical insulation, it can be manufactured either transparent or colored, and its manufacturing process is

easier than manufacturing metal (Al-Samarrai, 2013). plastic has revolutionized our lives, millions of tons of plastic are used worldwide, plastic waste has raised many problems in the environment and even food, plastic is made by adding different chemical additives with many varieties (APME, 2006). Plastic is one of the most versatile materials, because of its light weight, corrosion resistance, low cost, and electrical and thermal insulation (Andrady and Neal, 2009), with the increase in the continued use of plastic, especially in developing countries, its implications must be considered and disposed of (Teuten, 2009). Coat has a significant impact on the physical protection of food products during production, transportation and storage processes, fighting the product from damage and explaining its information (Karmaus et al., 2018). Since it is a multi-purpose plastic, it has a significant impact on the environment in addition to the economic and social risks (Sadan and De Kock, 2020), while ISO (2006) indicated that all coat manufactured from cardboard, it was better and had a lower impact on foodstuffs than glass containers and polyethylene phthalate (PET) containers, also High Density Polypropylene (HDP).

Effect of heat on plastic coats

Preserving foodstuffs in plastic containers and coatpers and placing them in refrigerators, it has been a popular preservation method for a long time, this preservation method has recently become controversial, the effect of these packages on the foods preserved in them, because of the harmful chemicals contained in these coatpers and their transfer of nutrients and the ease of their association with food components at a temperature of one degree Celsius, the impact on consumer health (Li et al., 2010).

The health impact of plastic coat

Plastic packaging materials contain chemicals, these substances can pass into food, lead to health problems, therefore, the consumer must be aware of the damages and health concerns associated with food packaging, as a result of improper use of plastics, need to educate consumers about the use of plastic coat, this requires unifying efforts to ensure that consumers are aware of the correct use of packaging (Magdi et al., 2021). Research indicated, however, that a binary compound (2-ethylhexyl-phthalate) used in medical coatpers was found, as it was discovered in human blood, many health risks may result from the large accumulation of it in the human body, therefore, modern scientific techniques must be used to solve all these problems, including striving to develop plasticizers that resist thermal decomposition, also, the use of biodegradable film (Rahman and Brazil, 2004). As Karmaus et al. (2018), it was shown that packaging made of recycled plastic materials must be safe when in contact with food, due to the harmful plastic components, it has been proven that (PBDE) polybrominated diphenyl ethers and (TTBPA) tetrabromobisphenol A, they work to disrupt the balance of thyroid hormones, in addition to the effect of polybrominated ethers on other hormones, and thus their impact on human health (Talsness et al., 2009). The chemicals in plastic

packaging materials interact with food, and among these harmful and dangerous compounds (BPA, bisphenol) are bisphenol alternatives, these substances lead to disruption of the endocrine glands (Karmaus et al., 2018). EDC is also considered a dangerous substance found in plastic packaging materials, causes an imbalance in the hormonal and biological systems (Martínez-Ibarra et al., 2020).

The temperatures at which packaged foods are handled help speed up the migration of chemicals in foods (Hoppe et al., 2016). It was found that these compounds have an effect on children and women of childbearing age (Koch and Calafat, 2009). As a result of the widespread use of plastic materials in packaging, it directly affected its users (Hopewell et al., 2009). Exposure to plastic additives and compounds that affect the endocrine glands was widespread in all segments of society (Meeker et al., 2009). Plastic production continued at a rate of 9% annually, and this amount is close to the percentage of the total world production in the last century (Thompson et al., 2009). Significant progress has been made in developed countries in order to use safe plastic packaging materials to protect consumer health (Ong et al., 2020).

Canada was the first country to ban the use of BPA in baby bottles in 2008, followed by the European Union, where it was used in 2010, Diphthalate (DEHP) found in plastic packaging has a significant impact on human health, this substance leaks from the plastic coats and thus has a great impact on the consumer as a result of its great solubility in fats (Kambia et al., 2003). Concern has led to the use of this substance in all types of packaging and packaging materials in all industries, whether food or medical, led the US Food and Drug Administration (FDA, 2018) to worry about the use of this substance, therefore, seeking to use healthy alternatives to this substance with a positive impact on consumer health (Hileman, 2002). It was found that this compound present in the coatpers increases filtration in food due to heat, was evident in cottonseed oil, where its filtration increased when the temperature increased (Lakshmi, 1998).

Plastic waste in the marine environment, including resin granules and plastic film residues, they contain dangerous organic pollutants for the marine environment, including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, petroleum hydrocarbons, and organochlorine pesticides (2,2'-bis (p-chlorophenyl)-1,1,1-trichloroethane, hexanes), these compounds are added during plastic manufacturing, while others are absorbed from the surrounding seawater. Thus, it affects marine organisms when they are eaten, it is transmitted to the human being when eating marine organisms, so it has a negative impact on the health of the individual (Emma et al., 2009). Therefore, consumers may be exposed to the risk of disease caused by plastic materials, as a result of the use of plastic coats containing harmful chemicals, if consumers continue to abuse plastic materials (Magdi et al., 2021). Chemicals that have a negative health effect on humans have been identified (fluorooctane sulfonate PFOS), resulting from migration from food packaging to food packaging. The concentration of this

substance in the serum and liver was found to cause hypolipidemia as an early effect of the cumulative doses. (Olsen, 2003). The Food and Drug Administration (2018) defines a food additive as any substance that is intentionally added to food, it has a functional effect on food, any substance in food packaging that is transferred to the food with an indirect food additive. Microplastics kill more than 100,000 marine mammals each year, as well as millions of birds and fish, it contains a million and a half albatrosses, that live in the Midway Islands in their digestive system on plastic (Eriksen et al., 2014).

Guern et al. (2019) showed that the subtropical sea water between the Hawaiian Islands and California, today they are areas of plastic accumulation which is known as GPGP (Great Garbage Patch), it consists of more than 80,000 tons of plastic waste. The European Union has sought to ban the use of plastic materials in detergents and cosmetics, in addition to reducing hazardous materials in plastic materials, to be assured that recycled plastic materials are free of harmful and dangerous chemicals that affect individual health (Ferreira et al., 2019). Bioplastics are used in food packaging, and the advantage of this packaging is not only their low impact on food, but it also has a positive impact on the soil, as its waste is used as a very important fertilizer, the bacteria work on analyzing these wastes and converting them into compounds that are easy to be absorbed by the soil, in addition, these coatpers are edible, as they are not harmful to health, although they are indigestible, as it is not necessarily able to be digested and absorbed, it still does not affect health. The matrix that arises from biodegradable plastic can be divided into three main sections, which are natural thermal plastics (polylactic acid (PLA), polyhydroxyalkanoates (PHAs) (Nagarajan et al., 2016; Vieira et al., 2011). Consumers are exposed to many dangerous chemicals found in many plastic coatpers, which are used to coat food as a result of the migration of these hazardous materials from the coatpers to the food, depending on the temperature of the food, the preservation period, and the ingredients of those coatpers. Studies have indicated that these substances, no matter how small they are, it leads to an imbalance in the various functions of the body, including the endocrine glands, which exposes the consumer to danger in his life (Vilarinho et al., 2019).

Al-Halfi (2010) indicated that the components of plastic in food packaging, it has a great effect on people with cancer, especially breast cancer, the result of the transfer of the chemical estrogen (Bisphenol A (BPA) contained in the reused containers, is also used in lining epoxy for containers used in cans, although at low levels. However, when it combines with estrogen in the body, it poses a great risk to people with breast cancer.

Alternatives to plastic coat

Biodegradable casings obtained from animal and vegetable proteins and even milk proteins can be used, these covers limit the harms resulting from plastic covers (Abdalrazeq et al., 2019). Interest has increased in the manufacture of edible

packaging based on carbohydrates, proteins, antioxidants, fats, and antimicrobials, being healthy and harmless materials in addition to being environmentally friendly materials (Han, 2014), also used as the main by-product of cheese-making, by-product, and its globular proteins were used as a polymer source to produce biodegradable coatings, at the same time, these products are recycled and disposed of as polluting the environment when they are not used. Processed films containing whey protein (WP) are obtained by heat treating these proteins in the presence of glycerol (GLY) as a plasticizer and at a pH of 7. It is possible to obtain materials derived from milk serum, it can be controlled without heat treatment, but provided that it is in alkaline conditions and at a pH of 12, as the water absorption of the different prepared membranes did not change compared to pH 7 (Abdalrazeq et al., 2019).

The agricultural polymers are starch and cellulose, and due to their abundance, they are among the most commonly used polymers, but their disadvantage is that it requires complex treatment methods before it is used as biological material, these methods usually increase their economic cost, sometimes it substitutes for protein which can be easily processed into many applications. Protein is used inexpensively in many sources available in nature (Fernández-Espada et al., 2016). The wide variety of plastic casings and their many uses has led to the development of improved plasticizers in order to obtain casings of high quality. Health safety issues have led to the development of a wide range of commercial plasticizers currently on offer. It includes some esters of fatty acids, tartars, chlorinated hydrocarbons, esters, adipic, and azelaic acid esters, with the continuous development of the plastics industry. The current market offers multiple choices of plasticizers with a range of advantages, which can meet critical material requirements, however, there were concerns, even controversy regarding the use of phthalates and their health effects on humans and the environment (Sunny et al., 2004).

Coatpers can also be used instead of plastic coats, it is made from non-toxic vegetable oils, components that do not affect the consumer, are biodegradable, and have little impact on the environment (Pedersen et al., 2008). Soybean, sunflower, flaxseed, and castor oils and their fatty acid esters have been used as substitutes for plastic coats (Baltacıoğlu and Balköse, 1999). Or the covers are in the form of edible or biodegradable films, including sugars, which have distinctive properties in forming films in many forms, in addition to providing effective barriers against fats, oils, and moisture, but it was more fragile than other films, as for protein films, they have better mechanical properties and barriers than polysaccharide films. Fat films also have excellent properties against moisture. However, they may cause problems with the sensory and structural functions of the packaged product. Therefore, modern industries have tended to form composite casings that include two or more of the aforementioned components (fats, proteins, and sugars) (Guilbert et al., 1997a; Guilbert et al., 1997b).

Many studies have aimed to highlight the necessity of using natural plasticizers as coatings to preserve the health of the consumer on the one hand and the product on the other, preserving the environment from pollution due to plastic coats. Plasticizers were also obtained from microbial sources and used as natural films for food products. Polysaccharide plasticizers such as cellulose, starch and pectin were also used, as they show distinct gas blocking properties (Tharanathan, 2003). As for oatmeal films, they were characterized by their ability to degrade with different plasticizers, such as hydrophilic plasticizers without changing their mechanical properties (Galdeano et al., 2009).

For the past decade, researchers have been interested in biodegradable polymers, to reduce the prevalence of solid waste related to petroleum-based plastics (Lim et al., 2008). Today these biodegradable polymeric materials are widely used in packaging and in all medical, agricultural and other industries, two major groups of biodegradable polymers can be distinguished, they are biodegradable natural and synthetic polymers. Produced from raw materials derived from renewable biological resources. The second group is biodegradable synthetic polymers produced from raw materials. Aliphatic polyester is derived from non-renewable petroleum resources and is a major part of the biodegradable polymers. They are hydrolyzable polymers due to the presence of chemical bonds that are sensitive to hydrolysis in their chemical composition (Li, 1999).

Biodegradable plastic coat can be used in food packaging, it can be used later as a biological fertilizer for the soil. The decomposition process is carried out by bacteria and fungi and is exploited for agricultural purposes, to improve the biodiversity of microflora, another advantage of biodegradable plastic coat is that it is edible but not indigestible (Nagarajan et al., 2016; Vieira et al., 2011). One of the biodegradable coats used in food packaging is Poly Lactic Acid (PLA), it is a biodegradable thermoplastic polyester produced by the condensation polymerization of lactic acid, which in turn is derived from the fermentation of sugars produced from corn and sugar cane (Drumrigh et al., 2000).

Polylactic is one of the renewable resources, due to its ability to biodegrade in addition to its low production costs, it is a promising biodegradable environmental plastic material, to replace conventional polymers, which are derived from petroleum in many industrial applications, in addition to its high hardness compared to many other thermoplastics, such as poly (ethylene terephthalate) (PET), poly (propylene) (PP), and high-impact poly (styrene) (HIPS) (Kfoury et al., 2013). Protein materials were used in the manufacture of plastic coats, it is used in many food industries. The biological waste can be used to extract these proteins, it is extracted through chemical treatments, then protein concentrates (del Mar et al., 2019) are obtained. Also, one of the proteins used in the coatpers is wheat protein and corn protein, where these proteins can form a dense glassy material with high thermoplasticity (Samarasinghe et al., 2008). It is also possible to use starch from potato peels, potato protein is a water-

repellent protein rich in amino acids, and it was used to produce bioplastics, food additives, films, or sheet production by thermoforming or compression molding (Jerez et al., 2009).

By our study of specialized scientific sources and research, should be careful not to use plastic coats, especially when used as coatpers for foodstuffs and foods, especially if they are hot, and go to vital coatpers, it is almost non-existent, in addition to not affecting the food packaged, some probiotic encapsulations have health benefits when taken with the encapsulated food item.

Conclusions

Plastic packaging materials contain chemicals that are harmful to individual health, which are transmitted to food and thus lead to health problems, therefore, the consumer must be aware of the damages and health concerns associated with food packaging, as a result of improper use of plastics, so the first step we need to educate consumers about the use of plastic coat, this requires unifying efforts to ensure that consumers are aware of the correct use of packaging. It is better to go to use bio-degradable covers, which can be obtained from animal and plant proteins and even milk proteins, it is of great benefit in two respects, the first is that it does not contain chemical compounds that are harmful to health, the other benefit is that it contains vitamins and other mineral elements that benefit the health of the individual. In addition, it is biodegradable and environmentally friendly, we can also use casings as an alternative to plastic casings, it is made of non-toxic vegetable oils with biodegradable ingredients that do not affect the consumer. Low impact on the environment, soybean, sunflower, flaxseed, and castor oils have been used as an alternative to plastic wrap, or the covers are in the form of edible or biodegradable films, including sugars that have distinctive properties in forming films in many forms, in addition to providing effective barriers against fats, oils and moisture, but it was more fragile than other films, as for protein films, they have better mechanical properties and barriers than polysaccharide films, fat films also have excellent properties against moisture. However, they may cause problems with the sensory and structural functions of the packaged product, therefore, modern industries have tended to form composite casings that include two or more of the aforementioned components.

Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

The author declares that the work has consent for publication.

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