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Preservatives in Canned Meat and Their Potential Human Health Concerns: A Review

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Abstract

Preservatives are the most popular food enhancers for preserving food freshness and extending its shelf life. Preservatives are frequently added to processed foods, so they are crucial to ensuring that the food remains fresh for a longer period of time. Several types of food preservatives are available currently some are manufactured while others occur naturally. Meat is one of the most important types of food that is disposed to chemical or enzymatic damage, especially after its manufacture as a result of the breakdown of fats, proteins and carbohydrates, which in turn causes the emergence of undesirable and unhealthy changes in smell, flavor and texture, making it unsuitable for human consumption. Among the substances allowed to be used as preservatives for canned meat are sodium acetates, nitrites, nitrates, sorbates, and sulphites. The current review aims to summarize the most important preservatives used in canned meat and indicate their potential negative impact human health.

1. Introduction

Food safety is a major issue for consumers across the world, and in recent years, the growing need for food safety has prompted study into the risks associated with consuming foods contaminated with pesticides, heavy metals, and toxins [1]. Markets all

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over the world are invaded by numerous types of processed animal and vegetable, food products in of metal, plastic and paper containers. Due to several factors such as unstable nature of man and his non-settlement in fixed places in ancient times, climatic conditions, seasonality of agricultural crops, economic level, development of knowledge, and trading, the idea of preserving food has evolved over time [2]. The importance of food preservation in this era has become a necessity and it has become crucial to know the effect of adding additives to food during preservation operations to resist biological and chemical factors of corruption. Consumers are concerned about the materials used for those purposes because it is important to guarantee the validity of the food without damage or spoil, whether for temporary or permanent preservation [3].

Food preservatives are industrial or natural chemicals added to foods to perform certain purposes such as preserving them from contamination and biological and chemical spoilage factors, in addition to being anti-rancidity and colored or flavoring materials that give food aesthetic spaces that attract consumers to purchase them. Large numbers of canned and preserved food products are invaded by various types of containers, metal, plastic and paper of these foodstuffs are numerous, including animal and vegetable various products.

Meat is well recognized as a great source of protein, lipids, vitamins, and minerals. However, oxidation and spoiling are among the most serious issues that meat product manufacturers must deal with [4, 5]. In a study by [6], results stated that volatile rosemary oil added to samples of canned red meat to test its effectiveness against *B. cereus* activity isolated from some canned meat products in vitro is, CFU / g after 9 days of preservation, compared to the samples to which Nisin A was added and the control, which was 49 and 45 g CFU, respectively. Additionally, according to [7], the volatile oil from *Cestrum nocturnum* flowers displayed antioxidant activity and when combined with minced beef, the duration of storage was extended to 15 days.

Because of the rich nutritional value of meat and its products, canning is one way to extend its shelf life. Additionally, considering the long-term risks posed by artificial preservatives to human health, canning is a good option. It was discovered that the antibacterial effects on beef were enhanced by using various pomegranate pomace concentrations as natural food preservatives. To improve the safety and quality of the meat, measurements of pH changes in beef at various levels and lipid oxidation values from various treatments are taken at various time periods.

Using pomegranate pomace increases the shelf life of beef by up to 10 days when compared to untreated samples, according to a research by [8]. Total bacterial counts, pH variations, and lipid oxidation values all demonstrate how employing pomegranate pomace in high concentration impacts the storage period. Meat supply safety, wholesomeness, and proper labeling and packaging are the responsibility of the United States Department of Agriculture (USDA)/Food Safety and Inspection Service (FSIS) [9].

2. Types of Food Additives

The most common preservatives are sugar, salt and vinegar (acetic acid), but there are numerous foods and food products to which chemicals are added to prevent the growth and reproduction of microorganisms, these chemicals are not components of those foods, but they are added from the production stage to consumption. In order to protect consumers, the health control and community protection departments in the developed world have devised many laws to protect consumers and the health of society from the ambition of illegal producing companies based on the expense of the health of the individual society [10].

The sources of food additives are either vegetable, seaweed, mineral, chemical compounds or of animal origins, therefore, food additives are generally divided into several groups:

1. Depending on the food's quality and manufacturing process, preservatives including sugar, salt, and vinegar are added in modest amounts.

2. Food is supplemented with antioxidants to stop or postpone chemical reactions that come from oxygen's interaction with fats, oils, and the family of fat-soluble vitamins.

3. Bleaching and maturing materials such as those used with flour, as it has the property of preserving it from insects and rodents.

4. Acids, alkalis and buffer solutions to maintain the acidity of materials, the pH degree has a great impact on preserving foodstuffs from spoilage.

5. Emulsifying agents, foams, stabilizers and thickeners, which work to mix non-mixable materials such as water and oil, which help to foam, mixing gases with liquids (soft drinks), while thickeners are used in making cakes, sweets and ice cream.

6. Scented materials, which are either natural or artificial.

7. Coloring materials are often natural and make food more attractive especially those used for baby food.

8. Artificial sweeteners like saccharin and aspartame, which are low in calories and safe for the teeth, are often used as a substitute for traditional sugar.

9. Substances that gain taste and smell are often used to cover some defects or deficiencies in the product or its components, including ethylvanillin, which is called vanilla.

10. Flavorings are added to the food produced that loses its original flavorings during manufacture, the most famous of which is: monosodium glutamate, which causes allergies in some people and is not recommended for use by pregnant women.

11. Stabilizers are added to give the product a distinct color, including carrageenan cellulose gelatin.

3. Canned Meat

Meat is one of the necessary foods for humans in all countries of the world, as it is considered one of the main sources of proteins in addition to fats and salts, meat is considered the best medium for the growth of various microorganisms, causing health and economic problems because of the speed of its damage in addition to the damage caused by food poisoning caused by these microorganisms as a result of their secretion of toxins [11, 12]. As a result of these factors, it have become necessary to preserve the nutritional value and freshness of meat and its products by using a variety of variables including holding time, temperature, light intensity during storage, transportation, humidity, atmospheric oxygen level, enzymes, and microorganisms [13]. Historically, a study by [2] stated that the first method of preserving meat was spontaneous fermentation where fermented sausages were produced from goat meat and lamb and meat was stored in caves. In 1811, Nicolas Appert developed a method for meat preservation by keeping the meat in closed containers [14, 15].

In addition to the fermentation method, salt has been widely used in food preservation in general and meat in particular, and salt is still one of the most common methods of food preservation where salt works to reduce the growth of microorganisms by providing a salty environment that is not suitable for the growth of these microorganisms and reducing their water activity [16].

Nitrides and nitrates are used in many foods and are essential ingredients used in the treatment of meat as preservatives and functional ingredients, and are known to be multifunctional food additives and powerful antioxidants [17]. Together with nitrides and nitrates, phosphates are used in meat products for a variety of purposes, such as pH stabilization and modifications, improving texture and organoleptic properties (tenderness, juiciness, color, and flavor), and extending shelf life [18].

Sorbates and benzoates function by eliminating bacteria and other microorganisms found in foods especially in acidic conditions. They are used in the preservation of a variety of foods ranging from salads, pickles, dairy products and meat [19, 20].

4. Preservatives Regulations and Health Concerns

According to [21], preservatives are divided into two groups: Antioxidants and Antimicrobials (Tables 1 and 2).

Table 1. Antioxidants.

Chemical agents	**Mode of action**
Ascorbic acid	Oxygen scavenger
Butylated hydroxyanisole	Free radical scavenger
Citric acid	Enzyme inhibitor
Sulfites	Enzyme inhibitor
Tocopherols	Free radicals scavenger

Table 2. Antimicrobials.

Chemical agents	**Mode of action**
Acetic acid	Destroy cell membrane function such as yeasts, bacteria, and molds.
Benzoic acid	Destroy cell membrane and inhibits enzyme such as molds, bacteria, and yeasts.
Nitrates and nitrites	Inhibit enzymes and destroy cell membrane function.
Sulfites and sulfur dioxide	Inhibit enzymes and forms addition compounds such as yeast and bacteria.
Sorbic acid	Inhibit bacterial spore germination such as yeasts, bacteria, and molds.

As defined by the FDA, Additives: means any chemical substance whose use directly or indirectly may causes or is expected to become part of the components of food or affect its properties, including any substance used at any stage of food production, manufacturing, packaging, storage, transportation and handling, and preservation including the source of radiation treatment as well as materials that may leak from packaging materials [22, 23].

According to the European Union, food additives can be defined as substances intentionally added to foodstuffs to perform certain technological functions, such as additives used as Colors, preservatives, antioxidants, sweeteners, emulsifiers, stabilizers, thickeners, and other sorts of additives were included in the list of food additives according to the *E* number [24, 25].

Some food companies choose and use different preservatives for canned food without considering the health and safety of the consumer example. For instance, some of them utilize preservatives such dimethyl bisphenol and bisphenol A, which have been linked to human cancer, such as uterine, breast, and vaginal cancers in addition to the potential health risks of toxic effects on the reproductive, nervous and immune systems, particularly in females, according to a recent American research [26].

Other food companies use preservatives to either give canned food a unique taste, color, or smell that satisfies the consumers. Other categories of preservatives is used in a variety of purposes including keeping canned food from spoiling as long as possible, satisfying consumers with a unique flavor, color, or aroma, or removing the food's pigment. The latest statistics of the US Food and Drug Administration indicate that there are more than 3000 types of preservatives that are now used in food preservation [21].

Many recent studies and researches indicate that many preservatives added to canned foods are harmful to human health because they can cause hazardous effects such as cancer and hepatomegaly, poor growth and reproduction, diabetes and heart disease in humans. Chemicals such as butylated hydroxyanisole and butylated hydroxytoluene are used as preservatives to prevent food from spoiling [27, 28]. In addition, the use of nitrates and nitrites as a botulism preventative and to enhance the flavor and aroma of canned meat has detrimental effects on human health because they are chemically linked to amines, which are naturally present in meat and the human body. This chemical linkage results in the formation of a substance called nitrosamine, which is directly responsible for the development of a number of cancers in the body [19, 25].

Sorbic acid (E200) is one of the most widely used preservatives as it does not pose a health risk to the human body when consumed in permissible doses, but rather has a positive effect on it, as it increases immunity and helps to remove toxins. Therefore, the permissible daily dose of sorbic acid for humans is 25 mg / kg of body weight [30], but there is evidence that when it is used, skin irritation can occur. From the negative effect, one can single out what E200 destroys in the human body, and its deficiency can cause neurological disorders, and in some case the death of nerve cells. The food supplement E200 is easily absorbed by the body, is not to not carcinogenic, and has antiseptic properties [31, 25].

Sodium benzoate (E211) is a food ingredient and preservative. It is fungistatic and bacteriostatic in acidic environments. When this substance is accidentally taken by a person as food additives, it has negative effects on the body (32). Moreover, High dosages of sodium benzoate administered over a short period of time to adult male rats may function as an oxidant substance, causing oxidative stress and cell damage. The preservative substance may result in problems in many human organs [33] .

5. Conclusion

Preservatives, both natural and artificial, are compounds that extend the shelf life of food by inhibiting the growth of microorganisms and eliminating oxidants. Despite the use of natural preservatives like salt, alcohol, vinegar, and sugar, toxic compounds used in the food business are directly related to a number of illnesses and adverse health impacts. Among the most important preservatives used in preserving meat are nitrates and nitrites, which under the influence of germs in the digestive system may turn these substances into nitrosamines known for its carcinogenic effect. These elements are harmful to the large intestine, lead to DNA disruption and make cells cancerous. That's why health authorities now recommend reducing frozen meat consumption and limiting meat consumption to small portions of fresh meat.

References

[1] Al-Azzawi, M.N., & Al-Ani, L.H. (2014). Determination of heavy metals in imported canned fish that sold in Baghdad markets. *Iraqi Journal of Science*, *55*(2B), 675-684.

[2] Czarniecka-Skubina, E., & Pielak, M. (2017). Żywność tradycyjna versus żywność wytwarzana przy zastosowaniu nowoczesnych technologii. *Zeszyty Naukowe Uczelni Vistula*, (*54*(3) Turystyka III), 165-178.

[3] Piwowarczyk, L. (2014). Clean Label–co właściwie oznacza. *Wiedza i Jakość*, *35*(2), 8-9.

[4] Jawher, I. M., & Hassan, M. G. (2022). Detection of some virulence genes of Pseudomonas aeruginosa isolated from meat at Mosul city. *Iraqi Journal of Veterinary Sciences*, *36*(5 Supplement I). https://doi.org/10.33899/ijvs.2022.135755.2512

[5] Ibrahim, A. B. (2023). Study on the effectiveness of adding some plant extracts with BHT on meat quality of lamb patties during chilling storage. *Iraqi Journal of Agricultural Sciences*, *54*(1), 147-155. https://doi.org/10.36103/ijas.v54i1.1686

[6] Abed, I. J., Ahmed, M. E., & MH AL-Shimmary, S. (2021). Rosemary volatile oil as a preservative agent in some canned meat foods. *Iraqi Journal of Agricultural Sciences*, *52*(1). https://doi.org/10.36103/ijas.v52i1.1247

[7] Salman, Z. O., Alwash, B. M. J., & Kadhim, E. J. (2019). Effect of essential oil of Cestrum nocturnum flowers cultivated in Iraq as antioxidant and elongation cold storage period of minced meat. *Iraqi Journal of Agricultural Sciences*, *50*(2).

[8] Hadab, N. S., & Dakheel, M. M. (2022). Application of pomegranate pomace as a natural antibacterial and antioxidant preservative in beef. *Iraqi Journal of Veterinary Sciences*, *36*, 211-216. https://doi.org/10.33899/ijvs.2022.135929.2544

[9] Al-Mahmood, O. A. (2023). Food safety and sanitation practices survey in very small halal and non-halal beef slaughterhouses in the United States. *Iraqi Journal of Veterinary Sciences*, 37(1), 1-7. https://doi.org/10.33899/ijvs.2022.133219.2191

[10] Smoley, C. K. (1993). Everything added to food in the United States. US Food and Drug Administration, 31.

[11] Faustman, C., & Cassens, R. G. (1990). The biochemical basis for discoloration in fresh meat: a review. *Journal of Muscle Foods*, *1*(3), 217-243. https://doi.org/10.1111/j.1745-4573.1990.tb00366.x

[12] Heinz, G., & Hautzinger, P. (2007). *Meat processing technology for small-to medium-scale producers*. RAP Publication 2007/20. FAO, Bangkok.

[13] Pressman, P., Clemens, R., Hayes, W., & Reddy, C. (2017). Food additive safety: A review of toxicologic and regulatory issues. *Toxicology Research and Application*, *1*. https://doi.org/10.1177/2397847317723572

[14] Moszyński, K. (1967). *Kultura ludowa Słowian: kultura materialna* (Vol. 1). Książka i Wiedza.

[15] Pisula, A., Pospiech, E., & Wiejskiego, S.G.G. (Eds.) (2011). *Mięso: podstawy nauki i technologii*. Wydawnictwo SGGW.

[16] Rahman, M.S. (Ed.). (2007). *Handbook of food preservation*. CRC press. https://doi.org/10.1201/9781420017373

[17] Long, N.B.S., Gál, R., & Buňka, F. (2011). Use of phosphates in meat products. *African Journal of Biotechnology*, *10*(86), 19874-19882. https://doi.org/10.5897/AJBX11.023

[18] World Health Organization. (2000). Benzoic acid and sodium benzoate.

[19] Bajcic, A., Petronijevic, R.B., Sefer, M., Trbovic, D., Djordjevic, V., Ciric, J., & Nikolic, A. (2021). Sorbates and benzoates in meat and meat products: Importance, application and determination. In *IOP Conference Series: Earth and Environmental Science* (Vol. 854, No. 1, p. 012005). IOP Publishing. https://doi.org/10.1088/1755-1315/854/1/012005

[20] US-FDA, C.F.S.A.N. (1982). Toxicological principles for the safety assessment of direct food additives and color additives used in food. Redbook.

[21] Food and Drug Administration. Microbiological considerations for antimicrobial food additive submissions [Accessed 2 March 2020] 2008.

[22] UK Food Standards Agency. (2011). Current EU approved additives and their E Numbers.

[23] EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS) (2012). Guidance for submission for food additive evaluations. *EFSA Journal*, *10*(7), 2760. https://doi.org/10.2903/j.efsa.2012.2760

[24] Thakore, K.N. (2014). *Butylated Hydroxytoluene*. Encyclopedia of Toxicology: Third Edition, 583-584. https://doi.org/10.1016/B978-0-12-386454-3.00263-3

[25] EFSA Panel on Additives and Products or Substances used in Animal Feed (FEEDAP), Rychen, G., Aquilina, G., Azimonti, G., Bampidis, V., et al. (2018). Safety and efficacy of butylated hydroxyanisole (BHA) as a feed additive for all animal species. *EFSA Journal*, *16*(3), e05215. https://doi.org/10.2903/j.efsa.2018.5215

[26] Wang, X., Nag, R., Brunton, N.P., Siddique, M.A.B., Harrison, S.M., Monahan, F.J., & Cummins, E. (2022). Human health risk assessment of bisphenol A (BPA) through meat products. *Environmental Research*, *213*, 113734. https://doi.org/10.1016/j.envres.2022.113734

[27] Ferysiuk, K., & Wójciak, K.M. (2020). Reduction of nitrite in meat products through the application of various plant-based ingredients. *Antioxidants*, *9*(8), 711. https://doi.org/10.3390/antiox9080711

[28] Karwowska, M., & Kononiuk, A. (2020). Nitrates/nitrites in food—Risk for nitrosative stress and benefits. *Antioxidants*, *9*(3), 241. https://doi.org/10.3390/antiox9030241

[29] Commission Regulation (EU) 2020/268 of 26 February (2020). Amending Annex III to Regulation (EC) No. 1333/2008 of the European Parliament and of the Council as regards the use of sorbic acid (E 200) in liquid colour preparations for the decorative colouring of egg shells (Text with EEA relevance) © EUR-Lex, 27/02/2020, eur-lex.europa.eu.

[30] Wood, R., Foster, L., Damant, A., & Key, P. (2004). *Analytical methods for food additives*. Elsevier. https://doi.org/10.1533/9781855737723

[31] Nair, M.S., Nair, D.V., Johny, A.K., & Venkitanarayanan, K. (2020). Use of food preservatives and additives in meat and their detection techniques. In *Meat quality analysis* (pp. 187-213). Academic Press. https://doi.org/10.1016/B978-0-12-819233-7.00012-4

[32] Shahid, M., Alwan, N.A., & Al-Masoudi, E.A. (2018). A study of toxic effect of sodium benzoate, vit. C alone and their combination on reproductive functions of adult male rabbits. *Basrah Journal of Veterinary Research*, *17*(3), 533-543.

[33] Al-Ameen, S.A., Jirjees, E.H., & Tawfeeq, F.K. (2022). Effect of sodium benzoate on some biochemical, physiological and histopathological aspects in adult male rats. *Iraqi Journal of Veterinary Sciences*, *36*(2), 267-272. https://doi.org/10.33899/ijvs.2021.129935.1705