

Analysis of Food Additives in Chocolate

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Abstract: Chocolate, because of its delicate appearance, sweet flavor and silky texture is very popular with the majority of today's population and has a broad market, occupying a place in the food industry and also promoting the development of the food processing industry. The additives used therein can enhance the storage properties of chocolate while maintaining its aesthetics, but if they are not used properly, they can cause many adverse effects. This paper mainly explores the widespread use of food additives in chocolate, to analyze the benefits and drawbacks that these additives bring to chocolate, and to reveal a profound link between the use of additives and their effects on chocolate and, despite reservations about their potential health risks, the need to standardize the use of additives and to rebuild consumer confidence in the safety and quality of chocolate. This paper is also important for the food industry to contribute to the development of knowledge on the application of additives in the production of chocolate and to provide ideas for future research and development of chocolate and its products and the use of food additives in them.

Keywords: Food additives; Chocolate; Application analysis

1. Introduction

Chocolate is a confection that combines cocoa beans, sugar and dairy ingredients with a variety of food additives that enhance its flavor, texture and mouthfeel, and has been shown to reduce negative emotions and improve recognition of happy expressions when consumed in moderation, as well as helping to reduce cardiovascular risk, oxidative and inflammatory burdens, improve cognitive functioning, and maintain the diversity of the intestinal microbiota. Some effective ingredients in dark chocolate may regulate blood flow mediated dilation, thereby enhancing endothelial function.^[1] According to the global market research report book, the global cocoa and chocolate market size reached \$48.3 million in 2022 and is expected to reach \$67.1 million by 2030, and consumer demand for chocolate is still on the rise. Based on past practical experience, the reason why the sales of chocolate in Europe have been increasing year by year is due to strong market demand. Some Asian countries, such as Japan, are also the main consumers of this type of food, and their handmade chocolate is very popular among consumers. Therefore, the use of additives in a wide variety of foods, especially the use of additives in chocolate has become an intriguing research topic, but also in order to make consumers feel more at ease, here we summarize the commonly used food additives in chocolate and their use, analyze the problems that need to be improved, in order to facilitate a more reasonable and standardized use of food additives, better maintain food safety, and thus promote the development of the entire food industry. This will facilitate the rational and standardized use of food additives, better maintain food safety, allowing consumers to purchase food with confidence and consume with peace of mind.

2. Types of food additives commonly used in chocolate

2.1 Sweeteners

Sweeteners or sugar substitutes, such as aspartame, sucralose, saccharin, acesulfame, neotame, advantin, stevia-derived substances, and rosmarinic acid, are ingredients used to sweeten and, in some cases, to enhance the flavor of foods.^[2] Non-nutritive sweeteners such as aspartame are more widely used and in higher demand in food products, and chocolate is an important use of sweeteners to modulate sweetness. In particular, sweeteners such as aspartame are considered high-intensity sweeteners because they require less dosage to achieve the same sweetness as sugar.

Specifically, sodium saccharin, if ingested in large quantities over a short period of time, may lead to problems such as acute massive hemorrhage and organ damage, which can lead to malignant toxicity, with the risk of carcinogenicity. Sweeteners, can bring harm to the human liver, especially for children with weak metabolism and detoxification functions. Acesulfame, Sucralose, as it stands, is relatively safe, but of course it needs to be in moderation. Sucralose is considered an extremely safe sugar substitute. Aspartame, when consumed in large amounts over a long period of time, it can easily trigger a series of diseases, such as migraines, and other related diseases, and has recently been classi-

fied as a Group 2B carcinogen.

2.2 Emulsifier

Emulsifier has been widely used in lotion food processing. Essentially, it is a liquid stabilizer, the nature of the emulsifier used determines the ease of emulsion formation and the functional properties of the final product. Emulsifiers are essential in chocolate production to miscible sugars and lipids in chocolate and prevent oil-water separation, ensure smooth and stable texture preventing product deterioration. Among the most widely used emulsifiers are soy lecithin, mono- and diglycerides, and polysorbate 80. If consumed in excess, they not only adversely affect the microbial community in the human gut, but may also lead to liver health problems.

2.3 Antioxidants

Antioxidants are added to chocolate to protect it from oxidative degradation that may occur during production and storage. Common antioxidants found in chocolate include natural extracts such as tea polyphenols, grape seed extract and apple extract. These antioxidants neutralize free radicals, prevent undesirable chemical reactions, and maintain the organoleptic properties of chocolate.

Specifically, butylated hydroxyanisole BHA, dibutylated hydroxytoluene BHT, and tertiary butylhydroquinone TBHQ, have high toxicity and side effects, and may adversely affect organs such as the liver, spleen, and lungs in humans. Care should be taken to avoid or minimize their toxic effects during food production. Vitamin C intake, on the other hand, is non-toxic and harmless.

3. Problems and development trends

3.1 Health concerns

Concerns about the possible health risks associated with excessive intake of certain additives in chocolate are also growing.

For example, obesity is considered to be a major health problem, which can trigger a series of pathological changes and even cause metabolic disorders in the heart, posing certain risks to the body, and is regarded as an evolutionarily new condition,^[4] The stability of gut microbiota helps to maintain normal metabolism in the body. In addition, it can also maintain energy homeostasis, allowing various organs and tissues of the body to operate normally. Imbalance of gut microbiota often triggers a series of mental illnesses, and studies have shown that dysbiosis of the gut flora may contribute to the pathogenesis of Alzheimer's proceeding, as well as modulating antitumor immunity and influencing cancer immunotherapy, while emulsifiers used in chocolate have been shown in studies to potentially produce adverse health outcomes in humans such as obesity, affecting gut flora, and promoting the onset of inflammatory bowel disease.

3.2 Standards issues

Food additive regulations in different countries differ in terms of permitted additives and their maximum permitted levels. These regulations are implemented to ensure the safety and quality of food products, including chocolate.

In the European Union (EU), the use of food additives in chocolate is regulated by the European Food Safety Authority (EFSA) and governed by the European Union Food Additives Regulation (EC) No 1333/2008. The regulation provides a list of permitted food additives and their conditions of use, including the maximum permitted levels for individual additives. The EU also sets specific maximum limits for different food additives, including sweeteners, emulsifiers, flavors and preservatives. These limits are intended to ensure that the consumption of food additives remains within safe levels for consumers.

The United States also has very strict regulations on chocolate processing and production, mainly supervised by the Food and Drug Administration (FDA). In the process of carrying out management work, the organization usually follows the Federal Code of Regulations (CFR), specifically Title 21, which covers both foods and drugs. The CFR provides a list of approved food additives and their permissible uses in chocolate. The FDA also establishes the maximum permissible levels of these additives to ensure their safety. Thorough evaluations and risk assessments are conducted to determine the safety of food additives before they are approved for use in food.

3.3 Safety assessment issues

In order to accurately assess the safety of food additives in chocolate, it is necessary to conduct a comprehensive risk evaluation. These recommendations take into account factors such as the harmfulness of the additive, the predicted exposure to the chocolate product being consumed, and the sensitivity of different subpopulations to its reaction. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is a key international organization whose main responsibility is to conduct safety assessments of food additives and to establish their acceptable daily intake (ADI) levels.

Despite the efforts of regulators and organizations to ensure the safety of food additives, we have to face the fact that there may still be some uncertainties and limitations in the assessment process. For example, certain additives may cause cumulative effects on human health over a long period of time, and the safety of these additives may be constrained by their individual characteristics and genetic predisposition. Therefore, continuous monitoring and research are essential for better risk assessment and to fill the knowledge gaps.

3.4 Development trend

Based on the analysis above, producers should ensure the quality and safety of their products, consider consumer preferences in depth and try to meet the expectations of consumer preferences. The implementation of food additive transparency campaigns in chocolate companies is a very meaningful thing to do. More research is needed in order to gain a deeper understanding of the actual effects of clean labeling campaigns in the chocolate industry and their long-term impacts.

First, foods with "clean labels", can mitigate the perception that processed foods are unhealthy. In the case of chocolate, for example, the clean label movement means avoiding artificial flavors, synthetic colors and chemical preservatives. For example, chocolate manufacturers can opt for natural compounds such as herbs, spices and plant extracts to be used as natural preservatives to extend the shelf life of food products. As clean labeling becomes more popular with consumers, such a technique for preserving food without adding a long list of additives or preservatives will become more valuable to food manufacturers. This trend will not only address health concerns and meet consumer demand for transparent and trustworthy foods, it will shape the future of food production, including the use of additives in chocolate.

Secondly, natural food additives will gradually become a popular trend. In recent years, a number of countries such as China has put forward a large-scale development of "natural, nutritious, multi-functional food additives," the green policy, which makes the food additives "back to nature" has become an irreversible trend at present. Observing the international market, we can see natural antioxidants such as tea polyphenols, natural sweeteners such as licorice extracts, natural antibacterial agents such as allicin, in addition, natural coloring and natural flavors are also widely welcomed in the international market. This shows that natural food additives will be more and more recognized by consumers and rapidly occupy the world market share of food additives. This fact indicates that food additives are heading towards a "natural" and "green" future.

Finally, compounded food additives are becoming a growing trend. These additives are formed by mixing two or more food additives. Compound food additives can not only meet the needs of rapid product development, to make up for the shortcomings of food manufacturers in product development, but also because of its synergistic effect, can relatively reduce the amount of additives in food, so that the people's dietary health has a positive impact on the compound food additives will become one of the mainstream of the development of the food industry in the future.

4. Conclusion

In conclusion, the study of food additives in chocolate has provided insights into the key findings of the potential pitfalls of these additives on human health, the urgency of developing standardization regulations, and the impact they have on consumer perceptions and preferences. It is hoped that the findings of this paper will provide useful insights for the food industry, and that future research should be more in-depth and focused on optimizing the analytical tools for food additives and exploring alternative additives that can satisfy both health and consumer needs.

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