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Preserving Freshness: A Dive into Types and Level of Jujube Fruit Preservatives in Samarahan, Sarawak

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ABSTRACT

Introduction: Jujube, also known as Chinese date, is a small, sweet fruit that grows on the Ziziphus jujuba tree. It's native to southern Asia but has been cultivated in many other regions around the world. The fruit is typically round or oval and can vary in size from a cherry to a plum. Jujubes can be eaten fresh, dried, or preserved and are often used in cooking, baking, and traditional medicine. They're rich in vitamins, minerals, and antioxidants, making them a nutritious snack option. Various food preservatives, including sulfur dioxide, are applied to jujubes before they are exported from their country of origin. Overdosing or overconsuming sulfur dioxide may cause severe adverse health effects, including cardiovascular and respiratory problems. Thus, this project is aimed to determine the type as well as level of preservative used in jujube that sold at Samarahan district, Sarawak.

Methods: Two samples of jujube fruits were obtained from the two largest jujube sellers in Samarahan district in January 2024. The samples were processed directly at the designated food laboratory for analysis of food preservatives, including formaldehyde, benzoic acid, sorbic acid, and sulfur dioxide.

Results: Sulfur dioxide was the only preservative identified in both samples, with a reading of 8 mg/kg. No formaldehyde, benzoic acid, or sorbic acid was detected in either sample. Conclusion: The present study indicates that jujube fruits sold in Samarahan district contain normal levels of food preservatives, with sulfur dioxide being the primary preservative utilized for jujube fruit.

Keywords: Jujube, Preservative, Sulfur dioxide

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INTRODUCTION

Jujube

Jujube fruit, also known as Chinese date, is a small but mighty gem that has captured the palates and imaginations of cultures around the world for centuries. Originating from the Ziziphus jujuba tree, this fruit boasts a remarkable blend of sweet flavour, chewy texture, and a myriad of potential applications, making it a versatile ingredient in both culinary and medicinal realms (Tepe et al., 2022).

In its natural form, the jujube fruit presents itself as a small, round or oval-shaped berry with a wrinkled, reddish-brown skin. When ripe, it offers a delightful burst of sweetness reminiscent of apples, accompanied by a satisfyingly chewy texture. This inherent deliciousness makes fresh jujube fruit an ideal snack enjoyed straight off the tree or incorporated into fruit salads, lending its unique flavor and texture to culinary creations (tepe et al., 2022; Chen et al., 2017).

Beyond its role as a fresh snack, jujube fruit extends its culinary influence into various realms of cooking and baking. From delectable desserts like cakes, pies, and puddings to savory dishes such as stews and sauces, jujube fruit adds a touch of sweetness and depth of flavor that elevates any dish. Its versatility shines as it seamlessly integrates into both sweet and savory recipes, offering a unique culinary experience with each bite (Lv et al., 2022).

Furthermore, the jujube fruit's versatility extends beyond the kitchen and into the domain of traditional medicine. For centuries, various parts of the jujube tree, including the fruit, seeds, and leaves, have been utilized for their purported health benefits. In traditional medicine practices, jujube fruit is believed to possess properties that promote relaxation, aid digestion, and boost the immune system (Zhang et al., 2022). Whether consumed fresh, dried, or in the form of teas and herbal infusions, jujube fruit serves as a potent ingredient in traditional remedies aimed at enhancing overall health and well-being.

Additionally, jujube fruit lends itself to preservation techniques, allowing it to be enjoyed year-round in various forms. Dried jujubes offer a convenient and portable snack, akin to nature's candy, while preserves and condiments made from jujube fruit add a burst of flavor to jams, jellies, and spreads (Tepe et al., 2022). These preserved forms not only extend the shelf life of jujube fruit but also provide a delightful addition to breakfast spreads, desserts, and snacks.

PRESERVATIVES IN DRY FOODS

Preserving the quality and safety of dry foods is paramount in ensuring their longevity and consumer satisfaction. With the increasing demand for convenience and longer shelf life, preservatives play a crucial role in maintaining the freshness, flavor, and nutritional integrity of these products (Lv et al., 2022).

Preservatives are substances added to foods to inhibit microbial growth, prevent spoilage, and extend shelf life. In the case of dry foods, which have low moisture content, preservatives are particularly essential as they face challenges such as lipid oxidation and microbial contamination despite their dry state (Lv et al., 2022).

Sulfur Dioxide

One common preservative used in dry foods is sulfur dioxide (SO2). Sulfur dioxide is commonly employed in preserving dried fruits such as raisins, apricots, and jujube (Lv et al., 2022). It serves multiple purposes, including preventing discoloration, microbial growth, and oxidation. By inhibiting enzymatic browning and microbial proliferation, sulfur dioxide helps preserve the visual appeal and safety of dried fruits, ensuring they remain appetizing and safe for consumption over an extended period (Lv et al., 2022).

One of the primary health concerns associated with sulfur dioxide as a food preservative is its potential to trigger respiratory problems, particularly in individuals with pre-existing respiratory conditions such as asthma or chronic obstructive pulmonary disease (D'Amore et al., 2020). Inhalation of sulfur dioxide can irritate the respiratory tract, leading to symptoms such as coughing, wheezing, shortness of breath, and chest tightness (Zhang et al., 2022). Prolonged or repeated exposure to high levels of sulfur dioxide may exacerbate respiratory symptoms and increase the risk of respiratory infections.

Furthermore, sulfur dioxide may elicit adverse reactions in individuals with sulfite sensitivity or sulfite allergy, a condition characterized by an abnormal immune response to sulfite-containing foods or additives (D'Amore et al., 2020). Symptoms of sulfite sensitivity may include skin rashes, hives, itching, flushing, abdominal pain, nausea, and diarrhea. Severe allergic reactions, such as anaphylaxis, are rare but can occur in susceptible individuals (D'Amore et al., 2020; Zhang et al., 2022).

In addition to its respiratory and allergic effects, sulfur dioxide has been implicated in cardiovascular health concerns. Exposure to sulfur dioxide has been associated with increased cardiovascular mortality, myocardial infarction, and exacerbation of cardiovascular diseases. The mechanisms underlying these effects are complex and may involve inflammation, oxidative stress, endothelial dysfunction, and autonomic dysregulation (Zhang et al., 2022).

Despite these health concerns, regulatory agencies

such as the Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) have established safety limits and guidelines for sulfur dioxide use in food products. These regulations aim to ensure that sulfur dioxide levels in food are within safe limits and do not pose undue health risks to consumers. Additionally, food manufacturers are required to label products containing sulfur dioxide as a preservative and provide information on potential allergen content to enable consumers to make informed choices.

Sorbic acid

Sorbic acid and its salts, such as potassium sorbate, are also favoured preservatives for dry foods. These compounds are effective against mold and yeast growth, making them suitable for preserving dried fruits, snack foods, and baked goods. By inhibiting the growth of spoilage microorganisms, sorbic acid extends the shelf life of these products while maintaining their quality and safety (De et al., 2021).

While sorbic acid is generally recognized as safe, concerns have been raised regarding its potential health effects, particularly in sensitive individuals. One notable concern is the possibility of allergic reactions to sorbic acid and its derivatives, potassium sorbate in particular, which may manifest as skin rashes, itching, hives, or gastrointestinal symptoms in susceptible individuals (De et al., 2021).

Moreover, some studies suggest that high concentrations of sorbic acid or its salts may have adverse effects on cellular health and metabolism. For example, in vitro studies have demonstrated cytotoxic effects of sorbic acid on certain cell lines, although the relevance of these findings to human health remains uncertain (Gupta et al., 2021). Additionally, there is limited evidence to suggest that sorbic acid may interfere with the gut microbiota, potentially affecting digestive health and immune function.

Furthermore, sorbic acid may contribute to the formation of nitrosamines, potentially carcinogenic compounds formed from the reaction of nitrites with secondary amines in the presence of acids (Gupta et al., 2021). While the risk of nitrosamine formation from sorbic acid alone is considered low, it underscores the importance of proper formulation and usage of sorbic acid in food products to minimize potential health risks.

Despite these concerns, sorbic acid continues to be widely used as a food preservative due to its effectiveness, cost-efficiency, and regulatory approval. Regulatory agencies have established safety limits and guidelines for sorbic acid use in food products to ensure that exposure levels remain within acceptable ranges. Additionally, food manufacturers are required to label products containing sorbic acid as a preservative and adhere to good manufacturing practices to minimize potential risks.

Benzoic acid

Benzoic acid and its salts, such as sodium benzoate, find application as preservatives in a variety of dry foods. These compounds exhibit antimicrobial properties against yeast, mold, and certain bacteria, making them suitable for use in dried fruit, fruit juices, and condiments (Seo et al., 2023). By preventing microbial spoilage, benzoic acid helps ensure the microbiological safety and stability of dry food products, preserving their freshness and integrity.

While benzoic acid is generally recognized as safe, concerns have been raised regarding its potential health effects, particularly in sensitive individuals. One notable concern is the possibility of allergic reactions to benzoic acid and its derivatives, particularly sodium benzoate, which may manifest as skin rashes, itching, hives, or respiratory symptoms in susceptible individuals (Gong et al., 2021).

Moreover, benzoic acid and its salts may undergo chemical reactions under certain conditions, leading to the formation of benzene, a known human carcinogen (Gong et al., 2021). Benzene can form in the presence of heat, light, and acidic or alkaline conditions, potentially posing health risks if consumed in significant amounts. While the risk of benzene formation from benzoic acid and its salts in food products is considered low under normal storage and usage conditions, regulatory agencies have established strict limits on benzene levels in beverages and other food items to mitigate potential health risks.

Additionally, some studies suggest that high concentrations of benzoic acid or its salts may have adverse effects on cellular health and metabolism. For example, in vitro studies have demonstrated genotoxic and cytotoxic effects of benzoic acid on certain cell lines, although the relevance of these findings to human health remains uncertain (Gong et al., 2021). Furthermore, benzoic acid may interact with other food additives or ingredients, potentially leading to synergistic or antagonistic effects on health (Gong et al., 2021).

Despite these concerns, benzoic acid continues to be widely used as a food preservative due to its effectiveness, cost-efficiency, and regulatory approval. Regulatory agencies have established safety limits and guidelines for benzoic acid use in food products to ensure that exposure levels remain within acceptable ranges. Additionally, food manufacturers are required to label products containing benzoic acid as a preservative and adhere to good manufacturing practices to minimize potential risks.

Fornaldehyde

Formaldehyde, a simple organic compound with the chemical formula CH2O, is widely recognized for its preservative properties and ability to inhibit microbial growth (Rahman et al., 2023). It functions by cross-linking proteins and nucleic acids, thereby preventing the growth of bacteria, yeast, and mold (Rahman et al., 2023). Due to its antimicrobial efficacy and low cost, formaldehyde has been used historically as a preservative in various industries, including food production.

In dry foods, formaldehyde is primarily utilized to prevent spoilage and extend shelf life. Its effectiveness as a preservative is particularly evident in products such as dried fruits, dried fish, and certain grain-based products. By inhibiting microbial proliferation and enzymatic degradation, formaldehyde helps maintain the freshness, flavor, and nutritional integrity of these dry food items, thereby prolonging their marketability and consumer appeal (Rahman et al., 2023).

However, the use of formaldehyde as a food preservative has sparked considerable debate and raised concerns regarding its safety. Formaldehyde is classified as a potential carcinogen by organizations such as the International Agency for Research on Cancer (IARC) and the U.S. Environmental Protection Agency (Putri et al., 2024). Prolonged exposure to formaldehyde has been associated with adverse health effects, including respiratory irritation, allergic reactions, and increased cancer risk.

Moreover, formaldehyde residues in food products have raised alarm among consumers and regulatory authorities. Excessive or improper use of formaldehyde as a preservative can led to the accumulation of harmful residues in food, posing risks to human health. Furthermore, formaldehyde may react with other compounds present in food, forming potentially hazardous by-products (Putri et al., 2024).

In conclusion, formaldehyde remains a controversial preservative in the context of dry foods, balancing its efficacy in preservation with potential safety concerns. While formaldehyde offers antimicrobial benefits and extends the shelf life of dry food products, its safety profile and regulatory status warrant careful consideration. As the food industry continues to innovate and prioritize consumer safety, ongoing research and regulatory oversight are essential to ensure the responsible use of formaldehyde and other preservatives in dry foods, safeguarding both product quality and public health.

MATERIALS AND METHODS

Samples

Dried jujube fruits were collected simultaneously from the two biggest jujube sellers in Samarahan district in January 2024 for the study purpose. One kilogram of dried jujube fruit was purchased from each seller by the principal researcher. Samples were directly transport to the designated food laboratory in Kuching district for the process purpose. The approval and ethical clearance from the Faculty of Medicine and Health Sciences (UNIMAS) was attained upon commencement of the study.

This study focusses on formaldehyde, sorbic acid, benzoic acid, and sulfur dioxide level. Hence, all the measurement procedure and process were strictly adhered to the protocol including MOH E03-020 (formaldehyde), MOH E03-002 (sorbic acid, benzoic acid), and MOH E03-007(sulfur dioxide).

Laboratory analysis and quality assurance:

All preservative analyses were performed at a designated Ministry of Health (MOH) food laboratory using routine regulatory compliance methods. Sample receipt, handling, and reporting followed accredited laboratory quality procedures (including documented chain-of-custody, equipment calibration, and internal quality control). Dried jujube samples were homogenised prior to analysis to improve representativeness and reduce within-sample variability. Preservatives were quantified using MOH reference methods: MOH E03-020 (formaldehyde), MOH E03-002 (benzoic acid and sorbic acid), and MOH E03-007 (sulphur dioxide)

For each analyte, laboratory quantification was performed against external calibration standards within the validated working range for the method, with analytical batches incorporating appropriate quality controls (method blank, calibration verification, and repeat/replicate analysis where applicable) to ensure accuracy and precision. Results below the laboratory's validated reporting threshold were recorded as not detected (ND) (i.e., below the limit of quantification/ reporting limit), consistent with regulatory laboratory reporting practice.

These MOH methods are used routinely for enforcement monitoring. Therefore, the analytical sensitivity is designed to be fit-for-purpose for detecting preservative concentrations relevant to Malaysian regulatory limits and public health decision-making.

RESULTS

All the four parameters (preservatives) were measured in mg/kg. Sulphur dioxide was the only preservative that identified from both samples. Both samples showed the value of 8 mg/kg for sulphur dioxide. Formaldehyde, sorbic acid, and benzoic acid were not detected from both samples.

DISCUSSION

Jujube fruit, also known as Chinese date, is a nutritious and delicious fruit enjoyed by many across the globe,

including local community in Samarahan, Sarawak. With its increasing popularity, ensuring its quality and shelf life becomes paramount (Chen et al., 2017). One method employed in preserving jujube fruit is the use of sulphur dioxide (SO2), a common food preservative.

Regulatory Interpretation (Malaysia)

Under Malaysia's Food Regulations 1985 (Sixth Schedule: permitted preservatives and maximum permitted proportions), dried/candied fruit products are permitted to contain sulphur dioxide (or sulphites calculated as sulphur dioxide) up to 2,000 mg/kg, while benzoic acid (or sodium benzoate calculated as benzoic acid) is permitted up to 350 mg/kg, and sorbic acid (or its salts calculated as sorbic acid) up to 500 mg/kg for "fruit candied; dried; dried candied" products .

In the present study, sulphur dioxide was detected at 8 mg/kg in both samples, which is approximately 0.4% of the Malaysian maximum permitted level (8/2000 × 100), indicating that the detected concentration is far below the regulatory limit and unlikely to reflect excessive preservative use. Benzoic acid and sorbic acid were not detected, consistent with non-use or levels below laboratory reporting limits, and suggesting no evidence of these preservatives being applied to the sampled jujubes.

Effectiveness of Sulphur Dioxide

Sulphur dioxide serves as a potent preservative due to its dual-action mechanism. Firstly, it inhibits microbial growth, preventing spoilage and extending the fruit's shelf life (Lv et al., 2022). Secondly, it acts as an antioxidant, mitigating enzymatic browning and preserving the fruit's colour, flavor, and nutritional integrity (Lv et al., 2022). In the case of jujube fruit, which is often consumed dried, sulfur dioxide plays a crucial role in maintaining its quality during storage and transportation.

Benefits of Sulphur Dioxide Preservative

The use of sulphur dioxide offers several benefits in preserving jujube fruit. Firstly, it enables the fruit to retain its desirable attributes, including taste, texture, and appearance, thus enhancing consumer satisfaction. Moreover, sulphur dioxide helps in standardizing the quality of jujube fruit, ensuring consistency in flavour and colour across batches (Lv et al., 2022). Additionally, by extending the fruit's shelf life, sulphur dioxide facilitates its distribution to distant markets, thereby promoting economic viability for growers and suppliers.

Drawbacks and Health Concerns

Despite its effectiveness, the use of sulphur dioxide as a preservative raises certain drawbacks and health concerns. One prominent issue is the potential adverse effects on sensitive individuals, including asthmatics and those with sulphite allergies. Sulphur dioxide can trigger respiratory symptoms and allergic reactions in susceptible individuals, necessitating strict regulation of its use in food products (Zhang et al., 2022). Furthermore, excessive consumption of sulphite-containing foods may pose health risks, such as headaches, nausea, and respiratory distress, underscoring the importance of prudent use and clear labelling.

Regulatory Measures and Alternatives

Formaldehyde is sometimes reported internationally as an adulterant added illegally to prolong shelf life due to antimicrobial effects; however, it is not listed as a permitted preservative under Malaysia's permitted preservative schedules, where only specified preservatives may be used for specified foods. In this study, formaldehyde was not detected in either sample, providing no evidence of adulteration with formaldehyde in the sampled jujube products.

CONCLUSION

The present study shows that dried jujube sold at Samarahan division utilised sulphur dioxide as preservative and the amount of preservative was within normal range. Nevertheless, continuous surveillance and monitoring of preservative level in dried foods is mandatory in safety guard the health and wellbeing of community and consumer.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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ETHICAL CLEARANCE

Ethical clearance for this study was obtained from the Ethical Board of University Malaysia Sarawak (UNIMAS).

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