A Study on Shelf Life Prolonging Process of Chili Soy Sauce in Malaysian SMEs’ (Small Medium Enterprise)

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Abstract. This research paper presents the possible solutions to prolong the shelf life of spicy (chili) soy sauce. The current spicy soy sauce formulation is without adding preservative which result in shorter shelf life. It is suggested to add chemical preservative to this spicy soy sauce in order to prolong its shelf life without jeopardising its prevailing taste. The proposed preservative is sodium benzoate. It is hope that by adding sodium benzoate, it can prolong the shelf life of the products from one year to two years without jeopardising the taste and quality of the products. The problem to extend the shelf life of spicy (chilli) soy sauce was 100% solved. The product could be extended to 2 years without adding any preservative (sodium benzoate) as the main raw material (soy sauce) purchased from “Kicap Jalen” had been added sodium benzoate as their preservative to prolong the soy sauce shelf life. All the physicochemical and nutritional analysis shown good results. As for the microbiological analysis, all the 3 samples shown good results on the total plate count.

Keywords: spicy, soy sauce, shelf life, sodium benzoate

1. Introduction

Soybeans have been consumed by Asian people in different types of traditional soy food products since 1000 years ago. There are many types of soy foods available on the market in eastern and western countries. Generally, soy foods are presented into two forms which are no fermented and fermented. Traditional no fermented soy foods include fresh green soybeans, whole dry soybeans, soymilk, tofu and whole-fat soy flour. The traditional fermented soy foods includes tempeh, miso soy sauce and fermented tofu. In addition, soybeans have been produced using both modern processing technique such as adopted by large soybean-processing plants and traditional ways such as oriental processing techniques [3].

Spicy (chili) soy sauce is a condiment prepared with red chili and premium soybeans sauce as a primary ingredient. Spicy soy sauce is spicy chili hot and sweet. It has rich soy aroma and hot flavor will delicately add excitement to any dish. This spicy soy sauce is best for dipping any crunchy crackers. Moreover, spicy soy sauce can be used as cooking glaze or used to marinade. This sauce is widely used in classic Asian especially Javanese people. Current formulation is without added preservative in spicy soy sauce, except for readymade soy sauce that normally added with some preservative. This spicy soy
sauce are widely consumed amongst Malaysian, Brunei and Singaporean, making it highly demanding on market.

The making of spicy soy sauce involved lots of process and techniques. In addition, correct techniques and formulations will prolong shelf life, improve quality and safety of the products. However, microbial deterioration of spicy soy sauce is of major concern. Growth of moulds in spicy soy sauce results in changes in the organoleptic and microbiological which lead to spoilage. Moreover, the shelf life of current spicy soy sauce is only few months to one year. Hence, manufacturers is focusing on the options to prevent spoilage and quality changes during storage period.

Development and improvement on the formulation of spicy soy sauce is crucial step in order to produce clean and holistic products as well as longer storage life and safe for human consumption. This is a very crucial step in food production especially on usage of safe ingredients especially food preservative. In order to ensure an economical, safe and quality product that last for longer period, addition of chemical preservative such as sodium benzoate is most likely used method. According to [5] and [1], sodium benzoate is very suitable for food that exhibits acidic condition in order to obtain microbial stability and high quality of the products. In addition, [4] addressed that, sodium benzoate is extensively popular as preservative in acidic food such as condiments, paste and salad dressing.

This conceptual paper proposes a simple application procedures, incurs low cost and safe chemical preservative formulation for organoleptically acceptable and shelf stable of spicy soy sauce.

![Figure 1: Maji Chili Soya Sauce](image)

2. Solution

2.1 Prolong the Shelf Life of Spicy Soy Sauce

Sodium benzoate has the chemical formula NaC7H5O2; it is a widely used in food preservative, with an E number of E211. It is the sodium salt of benzoic acid and exists in this form when dissolved in water. It can be produced by reacting sodium hydroxide with benzoic acid. Benzoic acid occurs naturally at low levels in cranberries, prunes, greengage plums, cinnamon, ripe cloves, and apples.
Sodium benzoate is a preservative. As a food additive, sodium benzoate has the E number E211. It is bacteriostatic and fungistatic under acidic conditions. It is most widely used in acidic foods such as salad dressings (vinegar), carbonated drinks (carbonic acid), jams and fruit juices (citric acid), pickles (vinegar), and condiments. It is also used as a preservative in medicines and cosmetics. Concentration as a preservative is limited by the FDA in the U.S. to 0.1% by weight. Sodium benzoate is also allowed as an animal food additive at up to 0.1% concentration according to AFCO’s official publication.

2.2 Lab Testing

The researchers conducted some critical analysis for the company, namely the physicochemical, microbiological, organoleptic test and nutritional analysis of the spicy soy sauce. The test is very important to ensure the products saved to consume and can be accepted by the consumers. This analysis is very essential in order to determine the chemical composition of the existing sodium benzoate in the spicy soy sauce products. It will also provide the information related to the level of existing preservative and necessity to add extra sodium benzoate according to requirement by FDA in prolong the shelf life of spicy soy sauce.

The analysis samples include fresh spicy soy sauce product and also spicy soy sauce product with storage period of 1 year, 2 years, and 3 years old. All samples had been collected and send for analysis.

![Chemical preservative (sodium benzoate)](image)

Figure 2: Chemical preservative (sodium benzoate)

3. Results

Prolong shelf life of spicy soy sauce

In this study, the spicy soy sauce will be added with sodium benzoate and analysed for microbiological, chemical composition and physical sensory. In this analysis, values of fatty acids, moisture content, soluble solid content, chemical composition and total phenolic content will be determined. Previous studies has shown that sodium benzoate can improve shelf life of food products and also provide stability in variety of food products with high organoleptic acceptability and stable nutritional quality. Once it is proven to be provide long shelf life, the final protocol will be recommended and to be followed by industry for shelf stable spicy soy sauce.

The researchers collected samples from Maji Enterprise to conduct laboratory critical analysis on the product. The analysis conducted to the products were physicochemical, nutritional analysis, and microbiological analysis. The samples collected included storage study from 2013, 2015, 2016 and 2017.
The problem to extend the shelf life of spicy (chilli) soy sauce was 100% solved. The product could be extended to 2 years without adding any preservative (sodium benzoate) as the main raw material (soy sauce) purchased from “Kicap Jalen” had been added sodium benzoate as their preservative to prolong the soy sauce shelf life. Results of the analysis was shown in Table 1.

Table 1, shown the full analysis that were done for spicy (chilli) soy sauce. The analysis shown that the shelf life for the product could be extended for 2 years without adding any preservative (sodium benzoate). This was because the main raw material (soy sauce) was supplied / purchased from “Kicap Jalen” and the existing raw material had been added sodium benzoate to extend shelf life of soy sauce.

All the physicochemical and nutritional analysis shown good results. As for the microbiological analysis, all the 3 samples stated expired 2017, 2016 and 2015 shown good results on the total plate count except sample stated expired 2013 was not in good condition as the results on total plate count was $1.39 \times 10^3$ cfu/g. Product quality and safety to consume by the consumer the total plate count should not be more or exceed than $1.00 \times 10^4$ cfu/g.

Shelf life is different from expiration date. Shelf life is linked to food quality, expiration date to food safety. A product that has passed its shelf life might still be safe, but quality is no longer guaranteed. In most food stores, shelf life is controlled by using stock rotation. This means moving products with the earliest sell by date to the front of the shelf, so that most shoppers will pick them up first and so getting them out of the store. This is important, as stores can be fined for selling out of date products. Most shops, if not all, will have to mark such products down as wasted, leading to a loss of profit.

Shelf life is can be changed by many things: exposure to light and heat, transmission of gases (including humidity), mechanical stresses, and contamination by things such as micro-organisms.

Mathematically, product quality is often modelled using only one parameter, for example the concentration of a chemical substance, a microbiological index, or a physical parameter. Sometimes, the parameter picked is irrelevant.

The shelf life is an important factor to health. Bacteria are everywhere, and foods left unused too long will often get large amounts of bacterial living in them. It may be dangerous to eat them and lead to food poisoning. The shelf life itself cannot always be trusted to tell how safe it is to eat a certain item of food. For example, pasteurized milk can remain fresh for five days after its sell-by date if it is refrigerated properly. In contrast, if milk already has harmful bacteria, the use-by dates do not matter.
Table 1: Results of Physico-chemical characteristics, Microbiological, Nutritional Aspects and Shelf life studies of Spicy (Chili) Soy Sauce

| No | Parameters         | Sample1 Expiry | Sample2 Expiry | Sample3 Expiry | Sample4 Expiry | Commercial label on the product | Range                  | Remarks       |
|----|--------------------|----------------|----------------|----------------|----------------|---------------------------------|------------------------|---------------|
| 1  | pH                 | 4.32           | 4.16           | 3.99           | 3.85           | NA                              | 3.85 – 4.32           | OK Acidic     |
| 2  | Benzoic Acid - HPLC| 254.73mg/kg    | 152.23mg/kg    | 315.31mg/kg    | 433.16mg/kg    | NA                              | 152 – 433mg/kg        | OK Following FDA |
| 3  | Sorbic Acid        | NA             | NA             | NA             | NA             | NA                              | NA                     | NA            |
| 4  | Total Dietary Fibre| 1.41g/100g     | 7.76g/100g     | 2.67g/100g     | 5.66g/100g     | NA                              | 1.41 – 7.76g/100g    | OK FDA        |
| 5  | Total Calories     |                |                |                |                |                                 |                        |               |
|    | Energy             | 251kcal/100g   | 262kcal/100g   | 245kcal/100g   | 255kcal/100g   | 236kcal/100g                    | 236 – 262kcal/100g    | OK            |
|    | Fat                | 1.17g/100g     | 0.15g/100g     | 0.14g/100g     | 0.88g/100g     | 0.2g/100g                       | 0.14 – 0.20g/100g     | OK            |
|    | Protein            | 2.76g/100g     | 2.71g/100g     | 1.69g/100g     | 2.73g/100g     | 1.6g/100g                       | 1.60 – 2.76g/100g     | OK            |
|    | Moisture           | 32.04g/100g    | 32.01g/100g    | 33.44g/100g    | 34.94g/100g    | NA                              | 32.0 – 34.94g/100g    | OK            |
|    | Ash                | 7.40g/100g     | 6.51g/100g     | 6.84g/100g     | 5.32g/100g     | NA                              | 5.32 – 7.40g/100g     | OK            |
|    | Carbohydrate       | 56.64g/100g    | 58.61g/100g    | 57.90g/100g    | 56.12g/100g    | NA                              | 56.12 – 58.61g/100g   | OK            |
| 6  | Total Plate Count  | 2.55 x 10^2 cfu/g | 2.55 x 10^2 cfu/g | 2.55 x 10^2 cfu/g | 1.39 x 10^1 cfu/g | NA                              | (1-3) x 10^1 -10^3 cfu/g | OK FDA        |
Preservatives and antioxidants may be put into some food and drug products to make their shelf life longer. Some companies use induction sealing and vacuum pouches to add to the shelf life of their products. Here, in the study the sodium benzoate was added as preservatives to prolong the shelf life of the product, nevertheless the microbiological analysis also play as crucial factors for the food quality and food safety to be consumed by the consumer.

**Conclusion**

As the conclusion and summary from Table 1, the full analysis shown that the spicy (chilli) soy sauce is safe to consume after two years with regards to the food quality, food safety and also the microbiological analysis not exceeding $10^4$ cfu/g.

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