EVALUATION OF SMOKING TECHNIQUE TOWARDS FOOD PRESERVATION

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Abstract: Smoking technique has gained attention among the food industry players in extending the shelf life of the food products and maintaining the quality. Since most research involving the food smoking techniques was only focusing on the biological evaluation of smoked meats, this review highlights some chemical and biological quality evaluation of smoked food products. The effects of smoking technique with or without general-curing on the microbial population and pH of the smoked food products were evaluated. The bacterial number of *Salmonella* sp. was reduced along the processing chains from raw food to smoked food and cured smoked food with some negative detection after the smoking. Besides that, the significantly decreased pH ($p<0.05$) of the smoked food product has benefited the food preservation condition. Smoking technique with curing showed a decreasing trend on the bacterial population which increased the product shelf life. Hence, the smoking technique is recommended for extending the shelf life of food considering the initial microbial and also the food properties before and after smoking. This review will be a significant endeavour to the smoked food sellers and the consumers with an upgraded quality of food.

Keywords: Smoked products, food preservation, curing, quality, shelf life

1. Introduction

Smoking can be defined by cooking the food slowly and indirectly with the presence of smoke. In order to extend the shelf life of food products with the addition of improving flavour, smoking as the preservation technique has been introduced back to the historical period and gained more attention especially in food industries nowadays. As a modification of the salting method used back in ancient times, nitrates and nitrites are used in order to fasten the curing time (Govari & Pexara, 2015). In this review, the general curing agent evaluated was the combination of nitrite, sodium chloride (salt) and turmeric powder. The pH of the food before and after smoked preservation will be determined as the pH of the smoked cured food also raises the question on how does smoking affect the pH of the food products? Previous studies have identified several spoilage microorganisms in raw and smoked products. Due to there is no in-depth review of foodborne pathogens, the determination of *Salmonella* sp. in smoked food will be reviewed further.

2. Discussion

2.1. Evaluation of *Salmonella* sp. presence in smoked food

In a study by Sheng and Wang (2021), 156 smoked fish samples were collected from both domestic and international sources; the domestic samples were found to be *Salmonella*-free, whereas five imported samples were found to be infected. Meanwhile, a total of 66 fish samples were obtained by Gildas et al. (2019), including both fresh and processed fish. In a number of samples, *Enterobacteriaceae*, *E. coli*, *B. cereus*, *C. perfringens*, yeasts, and moulds were found, but *Salmonella* sp., *L. monocytogenes*, and *S. aureus* were not detected. According to Chau et al. (2017), there is no presence of *Salmonella* sp. in the sampling of pre-packaged smoked salmon from supermarkets between September 2011 and January 2012. In addition, Dien et al. (2019) concluded that liquid smoke at a concentration of 1% successfully inhibited bacterial growth in general by reducing TPC, as well as harmful bacteria like *Salmonella*.

2.2. Effect of smoking technique on pH

According to Rana et al. (2021), the pH level in smoked Chub mackerel fillets decreased significantly ($p<0.05$) with smoking time at 20, 25, and 30 minutes, respectively, before it reached its acceptable limit (pH = 6.32–6.22). Meanwhile, a study by Popelka et al. (2021) on whole mackerel discovered that the pH of the (unpacked) group began to rise significantly ($p<0.05$) on day 28 of the experiment and then increased non-significantly until day 42. Indiarto et al. (2020) stated that the expected pH value at initial storage shows a decrease with the increased concentration of liquid smoke added. Lastly, Ratsimba et al. (2019) found that pork dried products had a higher pH than smoked products (6.48 ± 0.30 and 6.09 ± 0.54, respectively).

2.3. Effect of curing agents in smoked products preservation

According to Ziarati et al. (2018), sodium nitrite, $NaNO_2$ has been used as the curing agent on chicken meat and resulting in improvement of colour and taste, inhibits the antimicrobial activity with the addition of preservation and also as a cooking agent. The maximum amount of 300 mg of nitrite per kg can be used for the processing of ripening ham. However, not more than 150 mg of nitrite per kg is permissible in cooked meat products (Wójciak et al., 2019). If turmeric powder is added with nitrite, the colour of meat will be maintained, while not affecting the chemical composition of the meat. Furthermore, it was stated that with the addition of turmeric powder to the samples that were treated with nitrite, some factors would be affected to the upper level such as the moisture content, pH and also the microbial load of meat products (Gull et al., 2014). In the other hand, Ruiz-alonso et al. (2021) found that salting tilapia fillets for 4 hours in a brine containing 10% NaCl and then applying liquid smoke to the salted fillets resulted in smoke-flavored fillets with physical–chemical and microbiological qualities that met industry standards.

3. Conclusion

The findings show that the bacterial number of *Salmonella* sp. was reduced along the processing chains from raw food to smoked food and cured smoked food with some negative detection after the smoking. Besides that, the significantly decreased pH ($p<0.05$) of the smoked food product has

benefited the food preservation condition. Smoking technique with curing has improved the texture of the food products significantly ($p<0.05$) and showed a decreasing trend on the bacterial population which increased the product shelf life. More research needs to be conducted for better understanding the contribution of the smoking process combined with the curing agent and the amount of addition to be considered to improve smoked food quality.

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