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MODIFIED ATMOSPHERE PACKAGING OF A TRADITIONAL MALAYSIAN *NYONYA* CAKE: A PRELIMINARY STUDY

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1 Introduction

Nyonya kuih comprises a group of popular traditional Malaysian "cakes" made principally from rice (waxy and non-waxy), tapioca, and sago flours or starches. They normally have a shelf-life from 1-3 days at ambient storage temperatures (25°-30°C), depending on whether or not chemical preservatives are incorporated. The major problems relate to: (a) mould growth which becomes visible within a day or two, (b) development of a sourish off-odour which is likely caused by lactic acid bacteria and/or chemical deteriorative reactions, and (c) structural and textural changes brought about by staling or firming accompanied by syneresis or an exudation of fluids from the products. The perishability of these items limits their effective distribution on a large scale. Preservation cannot be effected by conventional methods such as thermal processing, freezing, and dehydration because of irreparable damage to the texture of these starch gel-based products. The use of chemical preservatives is viewed with suspicion and concern by many consumers and, therefore, provides a less than desirable solution to the problem.

In the present study, we looked into the possibility of enhancing the stability of preservative-free *nyonya kuih* through the application of modified atmosphere packaging (MAP) which has proven successful in extending the shelf-life of many non-respiring food products [1]. The effects of different atmospheres on syneresis were also compared. The product selected for this study was *kuih lapis* which may be taken as a typical example of *nyonya kuih* traditionally prepared by steaming.

2 Methodology

2.1 Sample preparation, packaging and storage

The product was prepared using the following formula: 250 g non-waxy rice flour, 600 ml coconut milk, 230 g cane sugar, and 0.5 g common salt. *Kuih lapis*, as its name suggests, is traditionally prepared in layers, each about 2-4 mm thick. Each piece of *kuih* would usually have eight or more variously coloured layers. In this study, for the sake of convenience, the "cake" was prepared in the form of a single thick layer without colouring. The ingredients were mixed into a batter which was poured into an aluminium tray to a depth of 6 cm, and steamed at atmospheric pressure for 40 min to ensure complete starch gelatinization. After cooling to room temperature, the *kuih* was cut into 5 x 5 x 3 cm pieces.

The "cake" pieces were placed in rigid polyethylene (PE) trays, each of which was then inserted into a flexible plastic bag made from 15/50 nylon/LLDPE (linear low density polyethylene). Certain bags were filled with oxygen-free nitrogen gas or a mixture of 50% N_2 + 50% CO_2 and heat-sealed. A permeable satchet of an active oxygen absorber (Ageless® Type Z-100PT), derived from active iron oxide, was inserted into other bags (below the bottom of the tray) before sealing. Products packed in air served as controls. The products were stored at 25°C and duplicate packages were withdrawn for analysis at appropriate intervals of time. The appearance of the samples was also noted.

2.2 Analysis

In headspace gas composition analysis, duplicate 25 μl samples of the headspace gas in each package was obtained using an air-tight syringe. After sampling, the holes were sealed using Selleys clear silicone sealant. The sample taken was immediately injected into a gas chromatograph (Hewlett-Packard Model 5890, Series II) equipped with a thermal conductivity detector and dual columns, one containing 80/100 chromosorb 102 and the other filled with 60/80 molecular sieve 5A, operating at 60°C. Helium, at a flow rate of 45 ml/min, was used as the carrier gas. Pure O_2 and CO_2 were used as standards.

For microbiological examination, samples were macerated with Butterfield phosphate solution using a Stomacher (Model 400). Serial dilutions were prepared using the same buffer. Total aerobic and anaerobic counts were determined using 3M PetriFilm™ plates which were incubated at 30°C for 48 h. Enumeration of lactic acid bacteria was carried out by preparing serial dilutions in MRS broth before plating onto PetriFilm™ plates and incubating in anaerobic jars at 30°C for 48 h. All determinations were carried out in duplicate.

The packaged products were also visually observed for surface mould growth and the occurrence of syneresis in order to estimate the mould-free shelf-life and the syneresis-free shelf-life, on the basis that the occurrence of either of these events would make the products unacceptable to consumers. The taste and odour of the products withdrawn for microbiological analysis were also noted.

3 Results and Discussion

All packages exhibited a general decrease in O_2 concentration with time. An increase in CO_2 concentration was also generally noted in all packages except those under 50% N_2 + 50% CO_2 which exhibited a cyclic pattern of CO_2 change. Ageless® was found to be effective in absorbing O_2 and in retarding the accumulation of CO_2 in the packs. The residual O_2 level in Ageless-containing packs was, however, generally higher than that in packs flushed with either N_2 or N_2+ CO_2.

The total aerobic plate count in air-packaged samples increased nearly 1000-fold within 2 days of storage at 25°C, by which time the product had become mouldy, acquired an off-odour, and exhibited unacceptable structural breakdown with the appearance of surface cracks and syneresis. At any particular storage time, both anaerobic and lactic acid bacteria (LAB) counts were more or less of the same order for any particular treatment, suggesting that LAB were the predominant bacteria found to grow in the products packaged under the modified atmospheres. The rate of growth of LAB or anaerobes showed little difference among the products packed under limited oxygen conditions.

From the microbiological point of view, the shelf-life of the products was limited by the appearance of moulds on the surfaces, even before off-flavour could be detected. This is not surprising since it has been reported that moulds can grow in atmospheres with O_2 concentrations as low as 1-3%, even in the presence of high levels of CO_2 [3]. According to Ooraikul [2], mould growth can only be completely suppressed when the headspace O_2 level is less than 0.4%. The type of packaging atmosphere had a more profound effect on growth of moulds than on LAB. Figure 1 compares the mould-free shelf-life of the products packaged under different atmospheres. No off-flavour was detected in all packs, with the exception of the control, at the end of their mould-free shelf-life. The use of Ageless® was found to be the most effective among the various treatments in extending the mould-free shelf-life of the product, even though the residual O_2 level in the headspace of packages containing Ageless® was much higher than that in the 100% N_2 as well as the 50% N_2 + 50% CO_2 packs. This suggests that the presence of other gases (i.e., CO_2 and N_2) may modify the effects of O_2 concentration on mould growth.

A comparison of the estimated shelf-life of the differently packaged products, based on visual detection of syneresis, is also given in Figure 1. It is obvious that MAP not only inhibits microbial growth but also retards, to some extent, starch retrogradation and syneresis. The effectiveness of the various treatments in delaying syneresis fell in the order: Ageless®/50% CO_2 + 50% N_2 > 100% N_2 > air. Carbon dioxide has previously been reported to delay the firming of bread and biscuits, although the mechanism by which CO_2 exerts such an effect remains unknown [4]. Figure 1 clearly shows that syneresis would make the product packaged under modified atmospheres unacceptable even before visible mould growth can be detected. For example, in packages containing Ageless®, the syneresis-free shelf-life was 4 days compared with the mould-free shelf-life of 10 days. Thus, the primary factor limiting the shelf-life of the product packaged under modified atmospheres is staling (and syneresis) rather than microbiological spoilage. Effort should thus be made to lengthen the syneresis-free shelf-life to make it comparable to, or even surpass, the mould-free shelf-life.

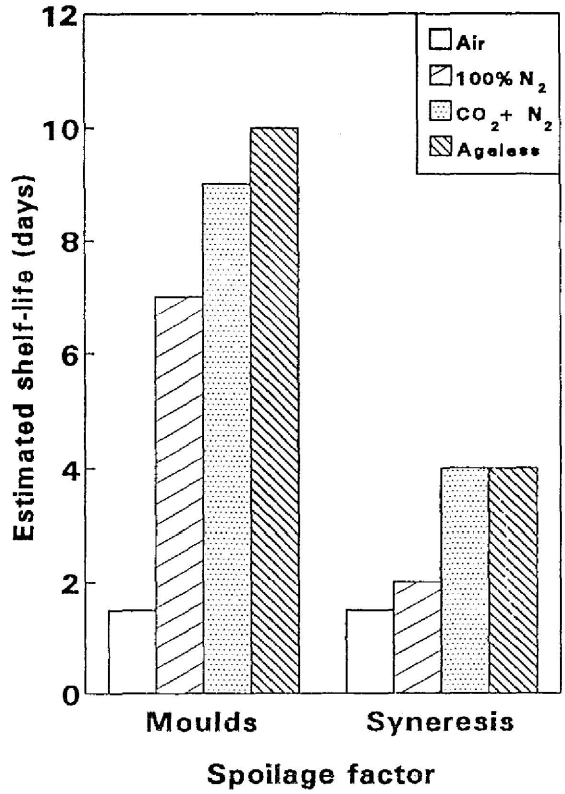

Fig. 1. Mould-free and syneresis-free shelf-life of kuih lapis packaged under different gas atmospheres.

4 Concluding Remarks

Short-term preservation of preservative-free *kuih lapis* can be attained using MAP technology. Packaging of the product under an atmosphere of CO_2 and N_2 at 1:1 ratio or in the presence of Ageless® would enable it to be distributed or displayed in air-conditioned retail stores for up to 4 days without organoleptic deterioration compared to 1.5 days for the air-packaged product. Further refinement of this technique is obviously required to improve its efficacy in extending the shelf-life of *nyonya kuih*.

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