Cost accounting for evaluating liquefaction of Thai fermented rice noodles and its prevention focusing on pH management

Traditional Thai fermented rice noodles, *khanom jeen*, are produced and consumed widely in the nation as well as the Greater Mekong Subregion. A well-known problem with noodle production is sudden noodle liquefaction soon after production, severely affecting business and undermining buyer confidence. JIRCAS found that the increased pH level of *khanom jeen* noodles induced liquefaction; noodles with weak acidic (pH 6) or alkaline (pH 8) buffers result in liquefaction, while acidic (pH 4) buffers do not (Research Highlight 2017, C01 "Liquefaction of Thai fermented rice noodles can be prevented by maintaining the product in acidic condition of pH around 4"). Thus, managing the pH level can be a promising method for preventing noodle liquefaction.

We conducted simulation analyses, including cost-volume-profit analysis, to evaluate the effect of liquefaction on small-scale rice and noodle producers' profitability and the cost of preventing the problem by focusing on pH management (Fig. 1). The results show that the instability of product quality, particularly noodle liquefaction, severely affects the profitability of flour and noodle producers (Fig. 2). Frequent pH level measurements at critical points of the production process can capture and prevent the risk of liquefaction. The cost for this is small (Table 1A), and simple to use digital meters are beneficial for measuring the pH of products at many different points. Incorporating practices to reduce high pH levels at appropriate points can reduce the risk of liquefaction. One approach is to wash the noodles with acid water (low pH) after the boiling process. The cost for this procedure is minimal and lower than using common food preservatives (Table 1B).

As mentioned above, the rudimentary management of the production process focusing on the pH level can secure product shelf life in the market and profitability. Note that the flour producer should adequately monitor and manage the fermentation, rather than merely reduce the products' pH at the final stage. A high pH level of the products just after solid- or liquid-state fermentation indicates something abnormal in the process that needs corrective action through reviewing operations. The noodle producer needs to consider that the amount of acetic acid for washing noodles depends on each site's water quality and the products' flavor. The results of this study should not be generalized without carefully considering the businesses' differences in technologies and capabilities, since the analysis is based on a small-scale noodles producer's data.

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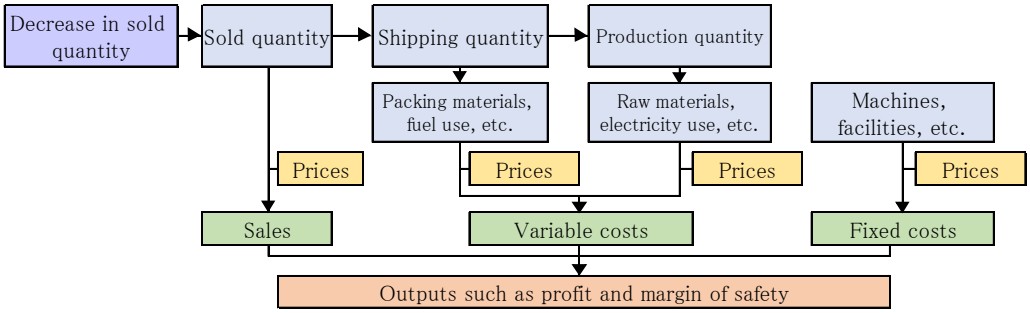

Fig. 1. Conceptual chart of the simulation model

Models for production of both the fermented rice flour and noodles are built based on the survey. The figure shows the common diagram for both processes.

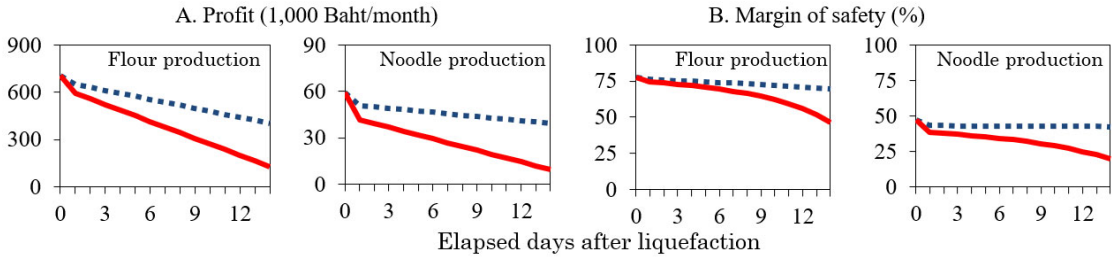

Fig. 2. Estimated profit and margin of safety according to the decrease in sold quantity

Solid line = 100% reduction in daily sales volume. Dotted line = 50% reduction in daily sales volume. "Noodle production" assumes that the process only uses purchased flour. It also assumes small businesses, an average size of fermented rice flour, and noodles producers registered with the Department of Industrial Works, Ministry of Industry (flour production: laborers = 13, raw material rice = 5.5 tons/day; and noodle production: laborers = 6, raw material flour = 0.6 tons/day). Only the sales volume is reduced on the first day, and the shipment and production volumes are also reduced to control variable costs on the second and subsequent days. The margin of safety measures the percentage decrease in monthly sales resulting in zero profit after the liquefaction.

Table 1. Monthly average costs for preventing liquefaction focusing on pH management

		For the surveyed company	For further pH management
A. Costs for measuring pH in the flour and noodle production processes by indicator papers	Measuring points (point/day)	10	20
	Costs (Baht/month)	373	746
	Percentage of total cost (%)	0.01	0.03
B. Costs for washing noodles by the water containing acetic acid	Volume of acetic acid (L/day)	0.2	1
	Costs (Baht/month)	216	1,083
	Percentage of total cost (%)	0.01	0.04

The surveyed company is the representative small-scale noodles producer, which uses a noodle-making machine that operates for 8 hours and produces 830 kg/day. The total cost for the surveyed company is 2.82 million Baht/month, with flour and noodle production accounting for 2.68 million Baht/month and 0.14 million Baht/month, respectively. The cost of measuring by pH meter is 431 Baht/month, assuming 6 years of durability. The cost of adding the maximum level of a common food preservative to noodles is 2,647 Baht/month.