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Research Article

Pilot-scale development of dried seasoning with Tom Yam flavour using mushroom as adsorbent

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Abstract

Tom Yam is a well-known healthy soup in Thailand. This research developed a dry seasoning with Tom Yam flavour by using a modified Tom Yam formula. Simmering for 30 min and a selected adsorptive method into mushroom were used in the production process. The moisture percentage and L*a*b* colour quality were 70.49%, 36.58, 17.60 and 29.85, respectively. By sensory evaluation of consumers aged 15-45, the product was found to be well accepted. The formula and adsorptive methods were then compared among five mushrooms. Grey oyster, pink oyster and abalone mushrooms demonstrated the highest adsorption ($p < .05$). However, grey oyster mushroom was selected because of its ease to find as a raw material source, cheapness and better flavour than other types. After temperature variation at 40-70°C, airflow velocity 0.71 m/s for 12 hours, the percentage moisture and 30-min rehydration of seasoning from grey oyster mushroom at 60°C were 12.80% and 177.80%, respectively. In addition, the resultant Tom Yam soup not only exhibited the best red colour intensity, but also the highest amount of dispersed oil. By the varying the drying time it was found that a 12-hour period was appropriate for the best product. The percentages of nutritive components such as moisture, ash, carbohydrate, protein, fat, crude fibre and energy were 7.72, 16.98, 61.77, 7.08, 2.12, 4.33 and 294.56, respectively. Microbial growth, examined by total plate count and yeast/mould count was not found in the dried seasoning product. The product acceptability by trained panellists showed a rather high average score (9.07 of 10) and the panellists suggested further product development would be to increase the sweet and spicy tastes while decreasing the saltiness.

Keywords: food product development, additives, sensory evaluation, Thailand

Introduction

Tom Yam, a traditional Thai soup, is one of the more famous soups in the world. It is a healthy food composed of spicy and sour as dominant tastes as well as blended herb flavours [1]. It is Traditional Tom Yam which contains sensitive and delicate flavours has usually been prepared by hand in small batches at home. Through hygienic industrial processing systems, Tom Yam cubes and paste, including instant dried powder, have been developed as seasoning for fast food. However, the flavours between factory-made and home-style Tom Yam are notably different [2].

Tom Yam mix is a potential functional food since three main ingredients, galangal root, lemon grass and kaffir-lime leaves, have health giving benefits such as anti-tumour and anti-cancer in the digestive tract [3, 4, 5]. Tom Yam ingredients have natural antimicrobial and antioxidant properties [6, 7, 8]. In addition, some ingredients such as garlic have antifugal, antiparasitic and antiviral activities, as well as antidiabetic, hypocholesterolemic and cancer preventive agents [6, 9].

Seasoning blend or mixed seasoning is a kind of seasoning comprising spices and herbs, but retain their physical and chemical properties after processing in unit operations [10]. In general, soluble seasonings, e.g., dry powder, viscous liquid and instant products have been developed for the food industry [11, 12]. The seasoning ingredients and processing conditions can affect the seasoning products such as temperature, moisture and production time [10]. The suitable chemical compositions, free moisture content and shelf-life are criteria are essential for good seasoning. By retaining their exotic flavour, the microbes contaminated from raw materials cannot be entirely removed, and the acceptable microbes with total plate count method are lower than 5×10^4 cfu/g [10, 13].

Tom Yam seasoning is an oily seasoning packed with instant noodle products [14]. Tom Yam products have also been developed by the controlled process, e.g., frozen Tom Yam [15]; changing raw materials, e.g., dried Som-Khaek as sour flavouring in Tom-Yam cubes [1], *Garcinia atroviaridis* as high acid source in Tom-Yam mix [12]. Tom-Yam cube and viscous liquid Tom-Yam product give slightly different tastes from traditional ones [2]. In this study, dried seasoning with Tom Yam flavour from mushrooms was developed by using the optimal processing conditions. The product quality has been examined in not only nutritive composition but also microbial growth and the product acceptability has been investigated for the next step of product development.

Materials and Methods

Raw materials

Spices and herbs such as chilli paste, lemon, lemon grass, kaffir-lime leaves, shallot (red onion), galangal root, bird chilli, basil and garlic were purchased from Bangkhae Market, Bangkok, Thailand. Five mushrooms, grey oyster, white oyster, pink oyster, paddy-straw and abalone, were purchased from Aranyik Mushroom Farm, Nakhon Pathom, Thailand.

Preparation of dried seasoning with Tom Yam flavour

Tom Yam ingredients were weighed in a proportion of modified Tom Yam formula and simmered in water for 30 min. Mushrooms were cleaned, air-dried and used as adsorbents.

Dried mushroom to Tom Yam soup of 1:3 were performed in all processes. The mushrooms adsorbed with Tom Yam soup were tray-dried in a hot air oven (TD 10, Owner Foods Machinery, Thailand) at a range of 40-70°C, airflow velocity 0.71 m/s for 12 hours. The size-reduction was performed after drying.

Food chemical analysis and microbial growth

The nutritive compositions such as moisture content, ash, total protein, total fat and crude fibre were determined according to AOAC methods [16]. The Hunter 'L*' (lightness), 'a*' (redness) and 'b*' (yellowness) values of the Tom Yam product were measured with a colourimeter (ColorFlex®, Hunterlab, USA). The microbial growths by total plate count and yeast/mould count methods were examined by using the USFDA method [17]. The dehydration and rehydration were investigated by a modified method from Bobić *et al*. [18] and Suguna *et al*. [19].

Sensory evaluation

After varying the concentrations of a modified Tom-Yam formula, the product was tested for acceptability by consumers aged 15-45 using the hedonic rank test. The data were statistically analysed by Friedman's rank test. Friedman's Least Significant (LSD) test at $p < .05$ was used for mean separation. The sensory evaluation for product development was done by using Quantitative Descriptive Analysis (QDA) with 20 trained panelists.

Statistical analysis

Five trials were conducted by using separate lots of raw materials on different weeks. Data were analysed using the general linear model (GLM) procedure of SPSS software (version 16.0 for Windows, SPSS Inc., Chicago, IL, USA). Means were separated using Duncan's New Multiple Range Test (DMRT) at $p < .05$.

Results and Discussion

Selection of adsorptive method

The effect of adsorptive methods using grey oyster mushroom as an adsorbent are shown in Table 1. There were no differences of moisture loss when using simmering mushroom in Tom Yam soup for 30 min, saturating mushroom in Tom Yam soup for 30 min and mushroom dried before saturating in Tom Yam soup for 30 min. The moisture loss percentage of the method using mushroom dried before simmering in Tom Yam soup for 30 min was less than others. However, all three methods except the method using simmering mushroom in Tom Yam soup for 30 min had undesirable Tom Yam characteristics. Therefore, the method using simmering mushroom in Tom Yam for 30 min was used for seasoning preparation.

Table 1. Moisture loss percentage after drying product by using four adsorptive methods.

Adsorptive method	Moisture loss percentage[1]	Product description
Saturating mushroom in Tom Yam soup for 30 min	81.74a ± 0.81	undesirable mushroom smell, no Tom Yam flavour, pale colour, low amount of mushroom rehydration
Mushroom dried before saturating in Tom Yam soup for 30 min	79.99a ± 0.81	undesirable mushroom smell, low Tom Yam flavour, pale red colour, no mushroom rehydration
Simmering in Tom Yam soup for 30 min	80.40a ± 1.02	Oily, Tom Yam flavour, red colour, high amount of mushroom rehydration
Mushroom dried before simmering in Tom Yam soup for 30 min	73.77b ± 3.63	undesirable mushroom smell, low Tom Yam flavour, pale red colour, low amount of mushroom rehydration

[1]The results are presented as (mean ± standard deviation) of five independent experiments. Values followed by a different letter indicate significant differences ($p < .05$) according to DMRT. Values with shared letter are not significantly different ($p \geq .05$).

Suitable concentration of Tom Yam soup

Each ingredient from a modified Tom Yam formula [14] was weighed in a range of 1.0-4.0 times. Tom Yam soup was prepared and the product acceptability investigated by using 30 consumers who were in the age of 15-45 years. Table 2 shows the effect of concentration level in the formulation on the moisture loss, L*a*b* colour and overall acceptance. There were significant differences of concentration levels for a* colour and overall mean acceptability score, but no differences of L*, b* colour and moisture loss were observed. 4.0 × initial concentrations received the highest score of 17.60, but it was not significantly different from 3.0 × initial concentration. Overall acceptance scores increased according to an increase of concentration level, and 4.0 × initial concentration had the highest score of 3.8. Using both a* colour and overall mean score in acceptability as selection criteria, 4.0 × was a suitable concentration for all experiments.

Table 2. Effect of concentration level on moisture loss, L*a*b* colour and consumers' mean scores for overall acceptance.

Tom Yam formula	Moisture loss (%)	Colour			mean score in acceptability
		L*	a*	b*	
1.0 ×	75.95ns ± 3.61	35.84ns ± 0.69	12.96c ± 0.43	30.02ns ± 0.15	1.0d
2.0 ×	76.74ns ± 2.94	35.84ns ± 0.69	15.25b ± 0.52	31.18ns ± 0.05	2.1c
3.0 ×	73.74ns ± 2.95	35.13ns ± 0.87	17.19a ± 0.92	29.98ns ± 0.14	3.1b
4.0 ×	70.49ns ± 1.61	36.58ns ± 0.84	17.60a ± 0.50	29.85ns ± 0.36	3.8a

The results are presented as (mean ± standard deviation) of five independent experiments. Values followed by a different letter indicate significant differences ($p < .05$). Values with shared letter are not significantly different ($p \geq .05$). ns means "not significant different at $p \geq .05$".

Selection of appropriate mushroom as adsorbent

Five mushrooms, grey oyster, white oyster, pink oyster, paddy-straw and abalone, were selected to find the most appropriate mushroom as an adsorbent for seasoning production. The percentages of adsorption and moisture loss of each mushroom are shown in Table 3. The result showed there were no significant differences of moisture loss among the mushrooms. However, abalone, grey oyster and pink oyster mushrooms had similar percentages of adsorption. Owing to ready availability, cheapness and better flavour than others, grey oyster mushroom was selected to use for all next experiments.

Table 3. Percentages of Tom Yam adsorption and moisture loss of seasoning from five mushroom types.

Mushroom	Adsorption percentage	Moisture loss percentage
Grey oyster	27.60ab ± 4.21	70.31ns ± 2.51
White oyster	20.18b ± 8.85	71.05ns ± 4.74
Pink oyster	33.60ab ± 10.86	69.05ns ± 3.21
Paddy-straw	–11.52c ± 2.09	72.86ns ± 1.30
abalone	35.89a ± 9.26	68.30ns ± 4.00

The results are presented as (mean ± standard deviation) of five independent experiments. Values followed by a different letter indicate significant differences ($p < .05$) according to DMRT. Values with shared letter are not significantly different ($p \geq .05$). ns means "not significant different at $p \geq .05$".

Selection of suitable production temperature and time

To investigate the appropriate conditions for producing seasoning with Tom Yam flavour, the variation of drying temperature and time according to Marimuthu *et al*. [20] and Saengow *et al*. [21] were performed at a range of 40-70°C and 9-12 h, respectively. Total solids, moisture, rehydration within 30 min and a_w were used as criteria to select experimental temperature and time (data not shown). The effect of drying temperature on seasoning product is shown in Table 4. Moisture percentage of product dried at 70°C was the lowest; however, the size reduction of adsorbed mushroom was very difficult. Comparing temperatures between 60°C and 70°C, the characteristics were not significantly different. There was no hindrance for size reduction at 60°C, and it was an economic way to produce Tom Yam seasoning by this process. For these reasons, 60°C was the most appropriate temperature for this production.

As the moisture content (dry basis) decreased in a linear relation to water activity (a_w) at 60°C (data not shown), the water activity was a criterion for eliminating microbial growth. The effect of drying time on seasoning production is shown in Table 5. Theoretically, the water activity in dried food should be lower than 0.600 [22] and the moisture of dried mushroom by any process except freeze-drying must be less than 12% [23]. Thus, 12 hours was reasonable for drying time of this seasoning production.

Table 4. Effect of temperature on moisture, L*a*b* colour and rehydration of seasoning product.

Temperature (°C)	Moisture (%)	Colour			Rehydration (%)
		L*	a*	b*	
40	27.83a ± 0.89	34.38c ± 0.04	16.43b ± 0.13	20.62b ± 0.34	121.62b ± 10.88
50	17.66b ± 1.58	33.42bc ± 0.91	16.54b ± 0.42	19.01b ± 1.28	158.50a ± 17.30
60	12.80c ± 2.01	38.81a ± 0.78	17.27a ± 0.27	24.48a ± 0.51	177.80a ± 8.04
70	9.09d ± 0.98	35.06b ± 1.64	17.61a ± 0.51	20.40b ± 2.26	178.71a ± 23.94

The results are presented as (mean ± standard deviation) of five independent experiments. Values followed by a different letter indicate significant differences ($p < .05$). Values with shared letter are not significantly different ($p \geq .05$). ns means "not significant different at $p \geq .05$".

Table 5. Effect of drying time on moisture, L*a*b* colour and rehydration of seasoning product.

Drying time (h)	Moisture (%)	a_w	Colour			Rehydration (%)
			L*	a*	b*	
9	15.03a ± 2.38	0.572a ± 0.024	37.10a ± 0.03	17.76a ± 0.06	31.11ns ± 0.13	70.20b ± 3.01
12	7.47b ± 1.62	0.463b ± 0.040	38.98b ± 0.05	17.44a ± 0.04	31.23ns ± 0.13	82.80a ± 1.04
15	5.61b ± 1.29	0.405c ± 0.033	43.42b ± 0.06	16.75b ± 0.07	33.51ns ± 0.21	91.40a ± 2.61

The results are presented as (mean ± standard deviation) of five independent experiments. Values followed by a different letter indicate significant differences ($p < .05$). Values with shared letter are not significantly different ($p \geq .05$). ns means "not significant different at $p \geq .05$".

Quality of seasoning with Tom Yam flavour

The product was investigated for physical characteristics and nutritive composition as shown in Table 6. Since the product had moisture content in accordance with Codex Alimentarius criteria and the water activity was lower than 0.600, the microbial growths examined by total plate count and yeast/mould count were not found in this product. Compared to the nutritive values of fresh grey oyster mushroom, this product had higher protein than fresh mushroom and had high crude fibre. Tom Yam soup from this product is oily red and had a good flavour like home-style cooking.

Table 6. Physical characteristics and nutritive compositions of seasoning product.

Physical characteristics		Value	Nutritive composition	Value
Moisture		7.72 ± 0.13	Ash (%)	16.98
Rehydration (%)		98.67 ± 3.75	Carbohydrate (%)	61.77
a_w		0.457 ± 0.004	Protein (%)	7.08
Colour	L*	33.09 ± 0.05	Total fat (%)	2.12
	a*	15.03 ± 0.05	Crude fibre (%)	4.33
	b*	27.75 ± 0.07	Energy (kcal)	294.56

The results are presented as (mean ± standard deviation) of five independent experiments.

By sensory evaluation on colour, texture and flavour (data not shown), the overall acceptability of this product was 9.07 ± 1.44 (of 10 *in toto*). Moreover, the sensory evaluation for product development using Quantitative Descriptive Analysis (QDA) was performed with 20 trained panelists. The panelists' suggestion results showed sweet and spicy tastes should increase a little and salty should also decrease a bit. Further studies on production of seasoning using other mushrooms for the good characteristics of various Thai soups including Tom Yam flavour will be investigated to develop the seasoning product. The large-scale production will be performed for knowledge transfer into the industry.

Conclusions

The pilot-scale production of Thai seasoning with Tom Yam flavour was developed. The best process to give a good flavour of this seasoning was to simmer the mushroom in 4.0 × initial concentration of Tom Yam soup for 30 min and then dry the adsorbed mushroom in the tray-dryer at 60°C for 12 hours. By this process, the seasoning product gave higher nutritive values than fresh mushroom and the Tom Yam soup of this product had good flavour and appearance like home-style cooking. The microbes were not found in the product. With the sensory test by QDA, the product quality will be improved for further large-scale production.

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