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Development of reduced-sodium seasoning powder using yeast extract

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Abstract

There is strong evidence of the link between excessive sodium consumption and cardiovascular disease. Therefore, the reduction of dietary salt intake needs to be implemented through the food production area as well. The objective of this study was to develop a reduced sodium seasoning powder using yeast extract. The effect of partially substituting sodium chloride with 0.5, 0.75 and 1% of yeast extract on sensory evaluation (9-point hedonic scale) and some physicochemical properties of this product were investigated using a completely randomized design. As the results, the most suitable formulation of a reduced- sodium seasoning powder replaced 60% of sodium with 1% yeast extract. The sensory evaluation showed no significant different between the reduced sodium product and the control ($p<0.05$) on flavor, taste, texture and overall liking scores. The developed product had water activity of 0.2 and the color values of L*, a* and b* were 67.21, 19.25 and 38.1, respectively. The sodium content was 698.33 mg/100 g sample, a reduction of 42.59% from the control formulation.

Keywords: Sodium, seasoning powder, yeast extract

Introduction

Salt (sodium chloride) has been used in foods for its preservative action and its distinctive flavor and ability to enhance the flavor of other ingredients. Sodium is an essential nutrient for normal physiological function in human body, which is required for maintenance of extra cellular fluid volume for the generation and transmission of electrical impulses in nerves and muscles and for the uptake of certain nutrients from the small intestine. However, its widespread use in foods has cause concern. A high dietary sodium intake is associated with increased risk of hypertension, which is a risk factor for the development of cardiovascular disease. According to World Health Organization (WHO) and Food and agriculture Organization of the United Nations (FAO) on sodium intake for population, the consumption is less than 5 g salt per day (WHO, 2003). Also, population-based studies had demonstrated that dietary sodium reduction towards the WHO guidelines could lead to a significant reduction in blood pressure and cardiovascular disease risk (Aburto et al. 2013). Reduction of salt in foods is now challengers facing the food industry today, which reduction of salt content of food can impact negatively on flavor and consumer acceptability.

Seasoning blend or mixed seasoning is a kind of seasoning comprising salts, oils, herbs and spices which is added to foods or snacks to enhance their flavor and smell (Underriner & Hume, 1994). Many seasoning are perceived as being high in salt, thus possibility contributes to the high sodium intake. Therefore, several strategies have been attempted to reduce sodium contents in these products. One of the most common methods is to replace sodium with salt substitutes such as potassium chloride, potassium lactate. Other techniques include flavor enhancers (Bolhuis et al. 2011), odor induced saltiness enhancement (Chokumnoyporn et al. 2015), and combined approaches, for example, using a salt substitute with a flavor enhancer (Campagnol et al. 2012). Yeast extract is an excellent and natural alternative, which widely uses as ingredients for the production of reduced salt food. The degradation of intracellular nucleic acid, protein and other macromolecular compounds produced the tasty substances such as amino acids and nucleotides (Chae et al. 2001). Moreover, yeast extracts has been used as flavor enhancers in low-sodium meat products, sauces, gravies, soups, chips and crackers (Campagnol et al. 2011).

In this study aimed to develop a reduced sodium seasoning powder by partially substituting sodium chloride with yeast extract. Some physicochemical properties were investigated and the sensory evaluation of this flavoring was evaluated by applying it on snack.

Materials and methods

Raw materials

The ingredient included sodium chloride (Thai refined salt Co., Ltd., Bangkok, Thailand), sugar (Mitr Phol Sugar Corp., Ltd., Bangkok, Thailand), monosodium glutamate (Ajinomoto Co., Ltd., Bangkok, Thailand), Disodium Inosinate-Guanylate and alanine (Thai Food And Chemical Co., Ltd., Bangkok, Thailand), full cream milk powder (ISM food products Co., Ltd., Samutprakan, Thailand), non-dairy cream (Nestle (Thai) Ltd., Samutprakan, Thailand), hydrolyzed vegetable protein-B (The

Mighty Co., Ltd., Bangkok, Thailand), paprika (o/s) (Nutrition Sc Co., Ltd, Nakhonpathom, Thailand), chili (Siam Makro Public Company Limited, Bangkok, Thailand), butter milk flavor (DPO (Thailand) Ltd., Bangkok, Thailand), cheese flavor (powder) and cheese flavor (oil) (Flavour World Co., Ltd., Tainan, Taiwan), anticaking (Thai Foods Group Public Company Limited, Bangkok, Thailand), maltodextrin (Thai Food And Chemical Co., Ltd., Bangkok, Thailand), yeast extract (Ohly GmbH, Germany) and cheese powder. To prepare cheese powder, full fat cheese (Fonterra Brands (Thailand) Ltd.) was dried in tray drier at 60°C for 4 hours (until moisture content at 4%), grounded with grinder mill and storing in an aluminum foil bag for the further study.

Study of the effect of salt reduction on seasoning

The control formula of seasoning powder was modified according to commercial seasoning (Kernel Season's, Elk Grove Village, IL, USA). The sodium reduction in seasoning powder was accomplished by partially substituting sodium chloride with different level of yeast extract. Each salt reduction sample was formulated to decrease sodium by 60%. Three samples were used following a Completely Randomized Design (CRD) with three replications. The formulation of all samples is shown in **Table 1** (control = seasoning powder without substituting of sodium chloride, $Y_{0.5}$, $Y_{0.75}$ and Y_1 = seasoning powder with partially substituting sodium chloride by 0.5, 0.75 and 1% of yeast extract, respectively). All ingredients in each formulation were weighed and mixed thoroughly in a conventional mixer at high speed for 1 min, before storing in an aluminum foil bag for the further study.

Table 1 Ingredients of seasoning powder samples.

Ingredients	Amount (%)			
	Control	$Y_{0.5}$	$Y_{0.75}$	Y_1
Salt (sodium chloride)	16.05	6.42	6.42	6.42
Monosodium glutamate (MSG)	10	4	4	4
Sugar	10	10	10	10
I+G	0.20	0.20	0.20	0.20
Alanine	1	1	1	1
Full cream milk powder	17	17	17	17
Non-dairy cream	21.75	21.75	21.75	21.75
HVP-B	6	6	6	6
Paprika (o/s)	0.80	0.80	0.80	0.80
Chili	3.5	3.5	3.5	3.5
Butter milk flavor, powder	0.25	0.25	0.25	0.25
Cheese flavor, powder	0.05	0.05	0.05	0.05
Cheese flavor, oil	0.3	0.3	0.3	0.3
Cheese powder	12.6	12.6	12.6	12.6
Anticaking	0.5	0.5	0.5	0.5
Maltodextrin	0	15.13	14.88	14.63
Yeast extract	0	0.5	0.75	1

Physical analysis

The water activity (a_w) was measured by an Aqualab water activity meter (Decagon, Pullman, USA). Each treatment was evaluated in triplicate, and each analysis was performed at room temperature. Color values of seasonings were determined using a spectrocolorimeter (ColorFlex EZ, Hunter Associates Laboratory, Reston, Virginia, USA). Color values were expressed as L*, a* and b* values where L* is the lightness component, positive a* is in the direction of red and negative a* is in the direction of green, positive b* is in the direction of yellow and negative b* is in the direction of blue. Each treatment was evaluated in triplicate.

Proximate analysis and sodium content

Moisture, protein, total fat, total carbohydrate, ash and sodium content were determined according to Association of Official Analytical Chemists (AOAC, 2016).

Sensory analysis

Sensory evaluation was conducted with 30 untrained panelists comprised of faculty members, staffs and graduate students of the Institute of Nutrition, Mahidol University (INMU), Thailand. The test was performed in an individual testing booth under the daylight-fluorescent lights of the sensory science laboratory at INMU. All samples were used as snack coating. Samples were coded using random three-digit numbers and served with the order of presentation counter-balanced. Panelists were provided with a glass of water and, instructed to rinse and swallow water between samples. They were given written

instructions and asked to evaluate the products for acceptability based on its appearance, color, flavor, taste, texture and overall acceptability using nine-point hedonic scale (1 = dislike extremely to 9 = like extremely) (Meilgaard et al. 1999).

Statistical analysis

The experimental data were analyzed using SPSS Statistics 19.0 (IBM, Chicago, Illinois, USA). Independent sample t-test or one-way Analysis of Variance (ANOVA and Duncan's multiple range tests were performed to compare mean value at the significance level 0.05.

Results and discussion

Effect of partially substituting sodium chloride with yeast extract on the physiochemical qualities and sensory evaluation of reduced-sodium seasoning powder

In this study, each salt reduction sample was formulated to decrease sodium by 60%. $Y_{0.5}$, $Y_{0.75}$ and Y_1 represent as seasoning powder with partially substituting sodium chloride with 0.5, 0.75 and 1% of yeast extract, respectively. The physicochemical qualities and sensory attribute scores of reduced-sodium seasoning powder samples are shown in **Table 2**. There were no significant differences in moisture content and water activity between three different amounts of yeast extract in seasoning powder formulation ($p<0.05$). Water activity is dependent on the solutes in the water (Adams & Moss, 2008) and the substitution was made by molar amount and the amount of salt solutes in the product was thus not changed. This is in agreement with Skogsberg (2016) who found that the water activity of reduced-sodium sausage was not affected by the substitution. For color values, the lightness (L*) and yellowness (b*) were slightly different between the formulas while redness (a*) showed no significant difference. This might be due to the color of yeast extract which is slightly dark yellow color. The observed results are thus in complete agreement with expected color results.

For sensory analysis, there were no significant differences in appearance and color attributes between three different amounts of yeast extract in seasoning powder formulation ($p<0.05$). The results of flavor, taste, and texture attributes of Y_1 showed to be significantly different with $Y_{0.5}$ but not significantly different with $Y_{0.75}$. Moreover, Y_1 obtained the highest overall liking score. This might be explained by the fact that yeast extract is used as salt enhancers, which enhance saltiness, activate taste receptors in the mouth and throat. Yeast extract contains natural 5'-nucleotides that can act as flavor enhancers and increase sensorial characteristics (Noordam & Meijer, 2007). The results were similar with Campagnol et al. (2011) who reported an improvement of sausage aroma and taste using yeast extract. Therefore, Y_1 was selected as a formulation of reduced-sodium seasoning powder.

Table 2 The physiochemical qualities and sensory attributes scores of reduced-sodium seasoning powder with yeast extract.

Physiochemical qualities	Formulations		
	$Y_{0.5}$	$Y_{0.75}$	Y_1
Moisture [A]	3.10 ± 0.03 [a]	3.08 ± 0.02 [a]	3.09 ± 0.01 [a]
a_w [A]	0.201 ± 0.004 [a]	0.200 ± 0.003 [a]	0.200 ± 0.003 [a]
Color [A]			
- L*	67.59 ± 0.23 [a]	67.13 ± 0.07 [b]	67.21 ± 0.18 [b]
- a*	19.14 ± 0.24 [a]	19.19 ± 0.04 [a]	19.25 ± 0.10 [a]
- b*	37.57 ± 0.31 [b]	37.94 ± 0.05 [ab]	38.13 ± 0.20 [a]
Sensory attributes[B]			
- Appearance	7.43 ± 0.82 [a]	7.43 ± 0.68 [a]	7.50 ± 0.78 [a]
- Color	7.33 ± 0.84 [a]	7.47 ± 0.63 [a]	7.50 ± 0.73 [a]
- Flavor	7.27 ± 0.98 [b]	7.37 ± 0.76 [ab]	7.73 ± 0.69 [a]
- Taste	7.23 ± 1.04 [b]	7.50 ± 0.82 [ab]	7.87 ± 0.97 [a]
- Texture	7.20 ± 0.66 [b]	7.50 ± 0.73 [ab]	7.67 ± 0.80 [a]
- Overall acceptability	7.30 ± 0.75 [b]	7.53 ± 0.68 [b]	7.93 ± 0.74 [a]

[A]Results are expressed as mean ± standard deviation (n = 3). The values with different superscript letters in the same row are significantly different ($p<0.05$).

[B]Results are expressed as mean ± standard deviation (n = 30), mean is based on 9-point hedonic scale where 9 = extremely like; 5 = neither like nor dislike and 1 = extremely dislike. The values with different superscript letters in the same row are significantly different ($p<0.05$).

Physicochemical qualities and sensory attributes of the control formula and reduced-sodium seasoning powder

The physicochemical qualities of control seasoning powder and reduced-sodium seasoning powder with 1% of yeast extract (Y_1) are shows in **Table 3**. It was observed that no significant difference in a_w between control and Y_1 formulation but there was significant difference in moisture content. However, the moisture content and a_w of both samples were safe for consumption criteria as according to the guideline of quality control in Thai regulations. The guideline of quality control reported that the moisture content and a_w should below 13% and 0.65, respectively **(**TCPS, 2004). The color values of reduced-sodium seasoning powder (Y_1) showed that the redness (a*) decreased slightly, while no significant difference in lightness (L*) and yellowness (b*) when compared with control product. The sensory evaluation showed that reduced-sodium seasoning powder obtained a lower score in color attribute than the control formula. This may be due to the lower redness color of the reduced-sodium seasoning powder. However, the results of appearance, flavor, taste, texture and overall acceptability attributes were shown to be not statistically significantly different. This means that the partially substituting sodium chloride with 1% of yeast extract did not affect the appearance, flavor, taste, texture and overall acceptability when compared to the control seasoning. Similar results were reported by Brandsma (2006) who found that salt content of a food can be reduced by 40-60% without affecting sensory properties using yeast extract. The sensory scores of reduced-sodium seasoning powder were in the range of like moderately to like very much (7.50-7.97).

Table 3 The physiochemical properties and sensory attributes scores of control seasoning powder and reduced-sodium seasoning powder with 1% of yeast extract.

Physicochemical qualities	Control formula	Reduced sodium seasoning with 1% of yeast extract
Moisture [A]	3.30 ± 0.01*	3.09 ± 0.01
a_w [A,ns]	0.201 ± 0.005	0.200 ± 0.003
Color [A]		
- L*[,ns]	67.26 ± 0.03	67.21 ± 0.18
- a*	19.85 ± 0.08*	19.25 ± 0.10
- b*[,ns]	38.29 ± 0.06	38.13 ± 0.20
Sensory attributes[B]		
- Appearance[ns]	7.70 ± 0.79	7.50 ± 0.78
- Color	7.97 ± 0.85*	7.50 ± 0.73
- Flavor[ns]	7.63 ± 1.07	7.73 ± 0.69
- Taste[ns]	7.73 ± 0.91	7.87 ± 0.97
- Texture[ns]	7.57 ± 0.82	7.67 ± 0.80
- Overall acceptability[ns]	7.77 ± 0.90	7.93 ± 0.74

[A]Results are expressed as mean ± standard deviation (n = 3).
[B]Results are expressed as mean ± standard deviation (n = 30), mean is based on 9-point hedonic scale where 9 = extremely like; 5 = neither like or dislike and 1 = extremely dislike.
* indicates significant difference at $p<0.05$ using independent sample T-test.
[ns] indicates no significant difference at $p\geq0.05$ using independent sample T-test.

Nutritive values and sodium content of the control formula and reduced-sodium seasoning powder

Nutritional values of the control seasoning powder and reduced-sodium seasoning powder with 1% of yeast extract (Y_1) are shown in **Table 4**. Reduced-sodium seasoning powder contained 30.62g protein, 8.85 g total fat, 52.07 g total carbohydrate, 3.66% ash per 100 g sample. Moreover, it was observed that protein and ash content of reduced-sodium seasoning powder were significantly lower ($p<0.05$) while total carbohydrate of reduced sodium seasoning was significantly higher ($p<0.05$) than that of the control. This was due to the addition of maltodextrin. Maltodextrin is a polysaccharide that is used as food additive to improve the mouthfeel of food and beverage (Denise et al. 2016). In addition, sodium content decreased from 1,216.33 mg to 698.33 mg/100 g per 100 g in the control formula and reduced-sodium seasoning powder, respectively, was significantly reduced by 42.59%. This was due to the reduction of salt (sodium chloride) in the formula. Reduced-sodium seasoning powder could be claimed as reduced salt or sodium according to Thai FDA regulation on nutrition labelling which reported that the food contains at least 25% less sodium than in the same amount of reference food.

Table 4 Nutritive values and sodium content of control seasoning powder and reduced-sodium seasoning powder with 1% of yeast extract[A].

Nutrition values (per 100 g)	Control formula	Reduced sodium seasoning with 1% of yeast extract
Protein (g)	31.50 ± 0.13*	30.62 ± 0.31
Total fat (g)[ns]	8.63 ± 0.47	8.85 ± 0.29
Total carbohydrate (g)	50.61 ± 0.51	52.07 ± 0.52*
Ash (g)	5.00 ± 0.06*	3.66 ± 0.06
Sodium content (g)	1,216.33 ± 47.37*	698.33 ± 10.07

[A]Results are expressed as mean ± standard deviation (n = 3).
* indicates significant difference at $p < 0.05$ using independent sample T-test.
[ns] indicates no significant difference at $p \geq 0.05$ using independent sample T-test.

Conclusions

The partial replacement (60%) of sodium chloride by 1% yeast extract creates a healthier product containing significantly less sodium (698 mg sodium per 100 g of reduced-sodium seasoning powder versus 1,216 mg sodium per 100 g of control seasoning powder) with acceptance sensory attributes. This study has shown the potential for using yeast extract to reduce sodium in seasoning powder. Moreover, the finding of this research may help to generate technology to diversify the use of yeast extract as salt enhancers in other food products in order to reduce salt intake.

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