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Oil Content Response of Tumpi-tumpi toFrying Process Condition

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Abstract : Tumpi-tumpi is traditional foods from South and West Sulawesi (Bugis-Makassar ethnic) in raw material of fish. Frying condition process e.q. the percentage of coatingmaterial, temperature and time will affect the quality and quantity of tumpi-tumpiproduced mainly in terms of oil content. The purpose of this study was to assess the oil content of the tumpi-tumpi, as the effect of frying process.This study used a software Design Expert 7.0® with Response Surface Methodology (RSM) Box-Behnken Design for select the frying conditions which produced an optimal response.The resultsbased on the RSM Box-Behnken design approach, it was known that the main effect of percentage of coating materials, temperature and frying time were the most significant factors to the value of tumpi-tumpi response (especially: oil content).The optimization used software Design Expert 7.0® with RSM Box-Behnken that produced the optimal processing formula with 1,5 of percentage of coating materials, 150°C of temperature and 30 s of time that produced the tumpi-tumpi was: 4,84% of oil content showed a low level.
Keywords: Tumpi-tumpi, frying, oil content, response surface methodology.

Introduction

Currently being promoted diversity of traditional food in Indonesia. The government is promoting and encouraging development of local food and study the typical food of the archipelago in an effort to food diversification for ensuring food security. Traditional food is part of the cultural treasures to be preserved,but its whereabouts are increasingly pressured by the foreign food that is more attractive, can be retained and modern imaged.One type of food products made from raw fish (meat pulverized) is Tumpi-tumpi, which is a traditional food of South and West Sulawesi (Bugis-Makassar ethnic).

Many urban communities are not interested in producing and reviewing traditional products such as tumpi-tumpi. Some of the things that cause abandoned traditional food products including the absence of archives, books or documents containing recipes, manufacturing procedures and nutritional value.

Study of tumpi-tumpi products is still very limited, there were study of examines some of the binder(1) and tried to reformulate tumpi-tumpi of tuna(2). Both of those studies are still limited to the quality characteristics especially how to get tumpi-tumpi with high protein content.On the other hand, consumer acceptance is very important to note, the main thing that affects the quality of the fried food product is oil content.One of the processing technologies that developing is deep fat frying. Engineering temperature and frying time was instrumental to the quality of the products produced primarily to water content and oil in fried products [(3)], which is expected to a minimum oil content in the product.Therefore, it needs to be optimized in the fryer to get the optimum formulation for the production of tumpi-tumpi as traditional confinience food.

The present study we observed the effect of frying condition on oil content in product of Tumpi-tumpi. We expected to be one of the technology package as an effort to develop tumpi-tumpi as ethnic food and can be commercialized.

Material and Method

The raw material used was milkfish (*Chanos chanos*),± 500 g weights/fish, origin from aquaculture unit derived from the people in Maros, South Sulawesi Province.Additional materials used for formulation of tumpi-tumpi (coconut, tapioca flour), spices (galangal, lemongrass, shallots, garlic, pepper, salt), water, cooking oil and chemicals pro analysis (p.a) for quality testing.The equipment used in the making oftumpi tumpi i.e. blades, preparations board, bucket/basin, meat grinder, scales, food processor, deep fat frying, freezer, plastic (LDPE), sealer.The tools used for laboratory analysis (chemistry and physics) including an analytical balance, oven, furnace, beaker, burette, micrometers pipette, homogenizer, Soxhlet extraction tool, choromameter (Minolta CR 400), Texture analyzer TA XT2i, thermocouples.The Oil content response was measured by following Ngadi *et al.*[(3)]

Table 1. Experimental design of tumpi-tumpi processing

Formula	Factor 1	Factor 2	Factor 3
	A:Percentage (%)	B:Temperature (^oC)	C:Time (second)
1	1.0	170	150
2	1.0	190	90
3	1.0	150	90
4	1.0	170	30
5	1.5	150	30
6	1.5	150	150
7	1.5	170	90
8	1.5	170	90
9	1.5	170	90
10	1.5	170	90
11	1.5	170	90
12	1.5	190	30
13	1.5	190	150
14	2.0	150	90
15	2.0	170	30
16	2.0	190	90
17	2.0	170	150

Result and Discussion

Response ofFrying Optimization

The results of experimental measurements of the response to tumpi-tumpi frying process can be seen in Table 2.

Table 2. The results of optimization response fryingtumpi-tumpi

Formula	Percentage	Temperature (^{o}C)	Time (second)	Oil content (%)
1	1.0	170	150	9.35
2	1.0	190	90	8.04
3	1.0	150	90	4.63
4	1.0	170	30	5.19
5	1.5	150	30	5.08
6	1.5	150	150	8.33
7	1.5	170	90	5.34
8	1.5	170	90	5.66
9	1.5	170	90	5.07
10	1.5	170	90	5.48
11	1.5	170	90	5.15
12	1.5	190	30	9.84
13	1.5	190	150	12.18
14	2.0	150	90	6.93
15	2.0	170	30	7.49
16	2.0	190	90	12.68
17	2.0	170	150	11.76

Based on Table 2 can be seen that the range of values in response to oil content of tumpitumpi product is 4.63% up to 12.68%. Results of analysis of variance (Table 3), indicating that the model chosen for the response of oil content is the cubic. Because this model that has a value R^2 is larger than the other model is 0.9978 for oil content.This model is also significant with p <0.05 (<0.0001) for the content of oil. Value Lack of Fit to oil content response showed Lack of Fit insignificant. Value Lack of Fit insignificant is a requirement for a good model because it shows a lack of compatibility response data obtained with the model [4, 5].

Table 3. Analysis model for experimental response

Response	Equation	Significant (p<0.05)	Lack of fit (p>0.05)	R^2
Oil content (%)	$-9.1975 + 71.7462A + 0.1275B + 0.0632C - 0.8892AB - 0.1411AC - 1.8958\times10^{-4}BC + 0.3800A^2 - 2.5625\times10^{-4}B^2 + 5.4097\times10^{-4}C^2 + 0.0473A^2C + 2.7875\times10^{-3}AB^2$	<0,0001	0,4638	0,9978

Response of Oil Content

Absorption of oil from a fried product is plays an important role because it will affect to quality of the product, especially on storage. Oil absorption or oil content is one indicator of efficiency in the frying process. Based on the modeling program to the response of the oil content of tumpi-tumpi products obtained cubic models. RSM equation for optimization tumpi-tumpi frying to oil content response is as follows:

$$\text{Oil Content} = -9.1975 + 71.7462A + 0.1275B + 0.0632C - 0.8892AB - 0.1411AC - 1.8958\times10^{-4}BC + 0.3800A^2 - 2.5625\times10^{-4}B^2 + 5.4097\times10^{-4}C^2 + 0.0473A^2C + 2.7875\times10^{-3}AB^2$$

Annotation:
A = Percentage
B = Temperature
C = Time

The above equation shows that the response of the oil content is influenced by the percentage of water and solids coating material, temperature, time and the interaction of all three. Increased oil content is influenced by the percentage of coating materials and frying temperature.Based on these equations can be said that tumpi-tumpi which has coated with a higher percentage and higher temperatures with a longer time, the oil content rate is also higher.Llorca *et al.*(6) states that there are several factors that influence the absorption of oil including oil composition, temperature and frying time, the form of product, composition and porosity pieces of food to be fried or the development of the crust during frying. The main factors affecting the content of oils in food products in the process of deep fat frying system is the water content and pressure changes (7).

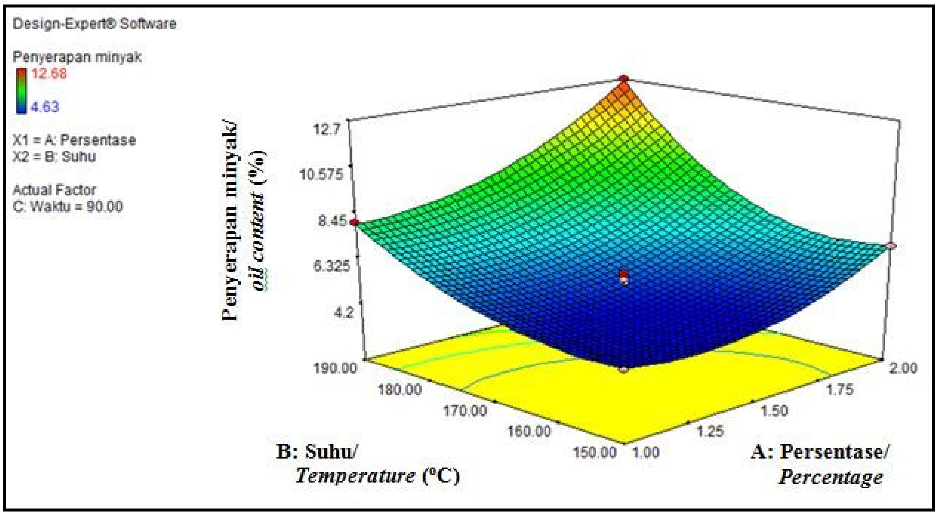

Figure 1. Three-dimentional graph of oil content response test.

Three-dimensional graph (Figure 1) shows the combination of components influence each response value of oil content. The colors are different on the graph shows the response value of oil content. The response of the lowest oil content 4.63% was obtained at 1.0 percentage formula coating material, temperature 150°C and 90 seconds indicated by blue, while the highest was 12.68% was obtained at 2.0 percentage formula coating material, the temperature of 190°C and 90 seconds indicated by the color red. This shows that the higher temperature of the frying pan and the more dilute coating material then the greater level of oil content.

In conditions where the concentration of coating that much (material coating is thicker/percentage of coating materials is low) in the product of tumpi-tumpi, resulting in oil as a medium for heat transfer can not reach the core product but only absorb the surface section of products, so that the absorption of low oil products for oil will be wasted. According Shandhu *et al.* (8) frying involves heat transfer of oil to the moving mass of food that results in cooking. The surface shape of the interaction between these components can be seen more clearly in the following three-dimensional graphics.

The Optimization of frying process of Tumpi-tumpi

Optimization is done with the intention of getting the process variables and the proper formulation on friedtumpi-tumpi by optimizing the response has been obtained. The response is said to be optimal if the desire values obtained (desirability) approaches 1. In the process of optimization of each variable and the response given weighting interest (importance) to achieve the desired objectives. The goal of optimization is to minimize the effort required or operational costs and maximize the expected results (4, 9). Table 4 shows the components are optimized, the target, the minimum and maximum, as well as the level of interest in the optimization phase formula.

Table 4.Optimize response, goal, limits, and importance in the optimization of formula

Response Component	**Goal**	**Lower limit**	**Upper limit**	**Importance**
Percentage (%)	Is target 1.5	1.0	2.0	3 (+++)
Temperature (^oC)	Is target 150	150	190	3 (+++)
Time (s)	Is target 30	30	150	3 (+++)
Oil content (%)	Minimize	4.63	12.68	4 (++++)

The results of optimization of making tumpi-tumpi using Design Expert 7.0® RSM-Box Benhnken Design for components and response yield 9 optimum process, with a value of 0.859 to 0.923 desirability. Optimum process suggested is that the top (solution no. 1) is the process of optimum value of the highest desirability, 0.923.It shows that 92.3% of tumpi-tumpi product produced has characteristics corresponding to the target optimization. Optimum process with the highest desirability value is the optimum process of making tumpi-tumpi by 1.5 percentage coating material, temperature 150^{o}C and frying time of 30 seconds. Estimates of the resulting response of the optimum process is oil content of 5.01%, the value of L 58.98, ^{o}hue 79.43, hardness 13363.2 gs, cohesiveness 0.56. Montgomery [4], states that the desirability value indicates the degree of precision of the optimal solution which is getting closer to one, the higher the accuracy of optimization.

Verification of optimum formula for frying Tumpi-tumpi

Verification was done to prove the predicted results and the value of the response solutions of optimum formula suggested by the program. The results of the verification and predictive value of optimum frying of tumpitumpi shown in Table 5. The verification results show that the process of frying tumpi-tumpi with coating material concentration of 1.5, temperature of 150^{o}C and frying time of 30 seconds for the response of the studywas in the range of 95% PI PI 95% low and high. It showed that the condition of the frying process to produce tumpi-tumpi with minimum oil content fairly consistent [10, 11, 12].

Table 5. Predicted and verified response value of optimum tumpi-tumpi

Response	***Prediction***	***Verification***	**95% CI* *Low***	**95% CI *High***	**95% PI** *Low***	**95% PI *high***
Oil content (%)	5,01	4,84	4,45	5,57	4,20	5,83

*CI = *confidence interval*
**PI = *prediction interval*

Conclusion

Formulation of the production process of tumpi-tumpi on various process conditions showed a significant effect on the response of the oil content.Optimization using Design Expert 7.0® RSM Box-Behnken Design produced optimal processing formula with 1.5 percentage of coating material, the temperature of 150^{o}C for 30 seconds. In this condition tumpi-tumpi generated by oil content 4.84%.

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