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Organoleptic Quality of Chicken Nugget with Broccoli (*Brassica oleracea L.*) and Carrot (*Daucus carota L.*) Addition

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ABSTRACT

This study aimed to determine the effect of cooking and level of vegetable addition and their interaction on the organoleptic quality of chicken nuggets. The research design consisted of 2 factors: the first factor was vegetable cooking treatment (fresh and steamed), and the second factor was vegetable addition level (0%, 10%, 20%, and 30%). The parameters measured were the organoleptic quality of chicken nuggets (color, aroma, taste, texture, and acceptance/hedonic). The results showed that cooking treatment had no effect (P>0.05) on the organoleptic quality of nuggets, but the level of vegetable addition affected (P<0.05) the organoleptic quality of nuggets. Increasing the level of vegetable addition decreased the color value of L*, a*, but increased the color of b*. Besides, the organoleptic test decreased the attribute scores of color, aroma, taste, and texture but was still accepted by panelists up to 30% vegetable addition level. There was no interaction between cooking treatment and the level of vegetable addition on the organoleptic quality of nuggets. It was concluded that using fresh vegetables at 10% had physical and organoleptic qualities that the panelists preferred.
Keyword: Chicken Meat, Broccoli, Carrot, Chicken Nuggets, Organoleptic

INTRODUCTION

Nugget is one of the processed meats that is ground and seasoned [1]. Mothers widely serve nuggets as a school lunch because children highly favor it. Nuggets have high protein content but could be better in dietary fiber and vitamins. The need for vegetables is one of the weaknesses of nugget products. Therefore, diversification of processed chicken nugget products by adding vegetables is needed.

Adding carrots to chicken nuggets sensory test concluded that adding carrots up to 20% in nuggets is acceptable based on the color [2], texture, and taste of the nuggets produced. Vitamin C content and antioxidant activity in chicken nuggets with broccoli and purple cabbage added concluded that the best treatment was the 15% broccoli + 15% purple cabbage formula, which had a preferred organoleptic [3].

Some of the vegetables that can be added are broccoli and carrots, which must be considered in proportion to the diet. The proportion of vegetables added to food can affect the product's physical and sensory properties [4]. Cooking treatment of vegetables will affect the nutritional content and functional properties of vegetables contained in carrots and broccoli. All cooking or food processing methods can reduce the nutritional content of food [5]. Nutrients can also be washed out by the water used for cooking; for example, boiling potatoes can cause the migration of vitamins B and C to the cooking water. All cooking treatments (boiling, steaming, or stir-frying) can reduce the levels of dietary fiber contained in vegetables [6].

Based on the given background, a study was conducted on the effect of cooking treatment, the level of vegetable addition of broccoli and carrots, and the interaction between both factors on the organoleptic quality of chicken nuggets.

MATERIALS AND METHODS

The materials used were 4,800 g chicken breast (Brest Boneless), carrot vegetables, broccoli vegetables (harvest period of 45 days), salt, garlic, pepper powder, chicken eggs, starch, wheat flour, blender, vacuum pump, scales, basin, stove, pot, spoon, plate, bowl, knife, cutting board, pan, spatula, and refrigerator.

This study used a completely randomized design (CRD) with 2x4 factorial and three replications. Factor A is the cooking treatment of broccoli and carrot vegetables, A_1 = Fresh and A_2 = Steamed. Factor B is the level of addition of broccoli and carrot vegetables B1 = 0%, B2 = 10% (Broccoli and carrots), B3 = 20% (Broccoli and carrots), and B_4 = 30% (Broccoli and carrots).

Research Procedure

Preparation Stage

The chicken meat used is Brest Boneless (BB) obtained from one of the RPA (Chicken Slaughterhouse) in Makassar. Four thousand eight hundred chicken breasts were prepared by removing the skin and other tissues for 2x4 treatments with three repetitions, each consisting of 200 g of chicken meat. The main ingredients used were broccoli and carrot vegetables. For therapy in formula B2 10% (10 g broccoli + 10 g carrots), in formula B3 20% (20 g broccoli + 20 g carrots), in formula B4 30% (30 g broccoli + 30 g carrots). To prepare vegetable ingredients, such as broccoli and carrots, remove parts that cannot be eaten or used and cut them into pieces. Then the vegetables were washed, blanched, or steamed for 5 minutes, then soaked in ice water for 10 minutes, and then ground using a blender as well as for fresh vegetables.

Nuggets-Making Stage

The chicken breast meat was cleaned first, then chopped or cut into pieces until the size became small to facilitate the grinding process. After the meat had been ground and smoothed, the flour and spices were mixed evenly, and the dough was mixed with broccoli and carrot vegetables according to treatments B1, B2, B3, and B4. Meat mixed well with vegetables was ready to be processed into nuggets.

The nugget dough is put into the mold that has been provided. After printing, the dough is steamed for 30-40 minutes. The cooked nuggets are cooled first and then cut into the desired shape. The nuggets are dipped in battered flour and then rolled in breaded flour before being fried. Nuggets smeared with battered and breaded flour can be stored in the freezer before being fried. The nuggets stored in the freezer are ready to be fried in hot oil until golden yellow, then drained before testing.

Measured Variable

Color

The color of chicken nugget pieces was measured using a Hunter Color Lab (Mini XE, Portable type) to record Hunter L*, a*, and b* values denoted by L* (lightness), a* (redness), and b* (yellowness).

Organoleptic Test

The panelists used were semi-trained panelists, totaling 30 people. Panelists are students who have undergone training and have been used in several studies at the Laboratory of Meat and Egg Technology, Faculty of Animal Husbandry, Hasanuddin University, aged between 17-24 years, sensitive to taste, not color blind, and not hungry. Panelists assessed the aspects of color (1 Very green, 2 Slightly green, 3 Greenish yellow, 4 Yellowish brown, 5 Slightly pale brown, 6 Very pale brown), aroma (1 Not very meaty, 2 Not meaty, 3 Slightly meaty, 4 Meaty, 5 Very meaty, 6 Very much meaty), taste (1 Doesn't taste like meat, 2 Doesn't taste like meat, 3 Slightly tastes like meat, 4 Tastes like meat, 5 Very much tastes like meat, 6 Very much tastes like meat), texture (1 Very not smooth, 2 Not smooth, 3 Somewhat smooth, four smooth and soft, 5 Very smooth, 6 Very smooth and soft) and hedonic (1 Dislike very much, 2 Dislike, 3 Somewhat like, 4 Like, 5 Like very much, 6 Like very much) for chicken nuggets with the addition of broccoli and carrots.

Data Analysis

Data processing was carried out by analysis of variance based on a complete randomized design (CRD) with a 2x4 factorial pattern and three replications using SPSS (version 16.0). Furthermore, if the treatment shows a significant effect, it is continued with the LSD (Least Significant Difference) test [7].

RESULTS AND DISCUSSIONS

Nugget Color

One of the properties that most attract the attention of consumers and the easiest to give an impression of liking or disliking is color. Color is a product property that can be viewed as physical (objective) and organoleptic (subjective), with humans as instruments. The research results on the color of chicken nuggets with the different addition levels of vegetables and different cooking treatments are presented in Table 1.

Table 1. Color of chicken nuggets with fresh and steamed broccoli (*Brassica oleracea L.*) and carrot (*Daucus carota L.*) vegetables and different addition levels.

Sample	Cooking treatment	level of vegetable addition (%)				Average
		0	10	20	30	
L*	Fresh	73.98±0.00	61.54±0.83	67.22±1.67	70.37±2.15	68.27±4.92
	Steamed	74.00±0.04	65.82±6.71	67.53±0.06	70.95±2.43	69.57±4.48
	Average	**73.9±0.03^{a}**	**63.6±4.87^{b}**	**67.3±1.07^{c}**	**70.6±2.08^{c}**	
a*	Fresh	5.62±0.00	2.50±0.84	1.91±0.19	1.84±0.38	2.96±1.67
	Steamed	5.59±0.04	2.13±0.47	2.06±0.65	1.88±0.31	2.92±1.65
	Average	**5.60±0.02^{a}**	**2.32±0.64^{b}**	**1.98±0.44^{b}**	**1.86±0.31^{b}**	
b*	Fresh	17.04±0.00	27.73±0.76	21.73±0.69	23.30±0.33	22.45±4.01
	Steamed	17.02±0.03	27.10±0.25	22.93±1.91	22.76±2.15	22.45±3.94
	Average	**17.03±0.02^{a}**	**27.41±0.61^{b}**	**22.33±1.44^{c}**	**23.03±1.40^{c}**	
Sensory Color	Fresh	4.93±0.86	4.30±0.70	3.03±0.66	2.17±0.46	3.61±1.27
	Steamed	4.93±0.86	4.47±0.83	3.17±0.79	2.20±0.61	3.69±1.29
	Average	**4.93±0.85^{a}**	**4.38±0.78^{b}**	**3.10±0.73^{c}**	**2.18±0.60^{d}**	

Notes: Different superscripts in the same row indicate significantly different treatments (P<0.05).

1. Color L* (Lightness)

The effect of cooking (fresh and steamed) and the level of vegetable addition on the L* color of chicken nuggets is presented in Table 1. The mean value of the vegetable cooking treatment on the L* color of the nuggets was highest in the steamed vegetable addiction treatment, with a value of 69.57, and lowest in adding fresh vegetables, with a value of 68.27. The results of variance analysis for cooking treatment on L* nuggets showed no significant effect (P>0.05).

The average value of the level of vegetable addition to the color of L* nuggets is the highest at 0% (73.99) and the lowest at 10% (63.68). The variance results for the level of vegetable addition to the L* nugget showed a very significant effect (P<0.01). This is by research [8] that stated the use of broccoli decreased the lightness value of sausage, but the lightness value was not affected by the percentage of broccoli. In this study, broccoli and carrots were added to the weight of the meat, which resulted in the dilution of myoglobin and reduced meat color [9].

The results of variance analysis for the interaction between the cooking treatment and the level of vegetable addition on the L* color of the nuggets found that it had no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so the LSD further test was carried out to determine the differences in each addition level.

The results of the LSD further test (Table 1) on the level of vegetable addition showed a difference in the L* of the nuggets from the treatment. Based on Table 1, the 10% level of vegetable addition differs from 20% and 30%. Then the 20% level is not different from 30%. Meanwhile, the 0% control treatment differed from all vegetable addition levels (10%, 20% and 30%).

2. Color a* (Redness)

The effect of cooking (fresh and steamed) and the level of vegetable addition on the a* color of chicken nuggets are presented in Table 1. The mean value of the vegetable cooking treatment on the a* color of the nuggets was highest in the fresh vegetable addition treatment with a value of 2.96 and lowest in the steamed vegetable addition with a value of 2.92. The results of variance analysis for the cooking treatment of a* nuggets showed results that had no significant effect (P>0.05).

The average value of the level of vegetable addition to the color a* nuggets is the highest at 0% (5.60) and the lowest at 30% (1.86). This shows that the higher the level of broccoli addition, the lower the redness value of the nuggets because broccoli contains pigments that cause green nugget products. The variance for vegetable addition level to a* nugget showed a very significant effect (P<0.01). This is by research [10] that indicates that duck meat nuggets added with broccoli and carrots will reduce the reddish color value of the product. Further mentioned by a study by Ahmad et al. [11] that the decrease in a value occurs due to increased denaturation of myoglobin.

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition on the color of a* nuggets found no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so the LSD further test was carried out to determine the differences in each addition level.

The results of the LSD further test (Table 1) on the level of vegetable addition showed a difference in the color of the a* nuggets from the treatment. Based on Table 1, the 30% level of vegetable addition was similar to 10% and 20% and vice versa. Meanwhile, the 0% control treatment differed from all vegetable addition levels (10%, 20% and 30%).

3. Color b* (Yellowness)

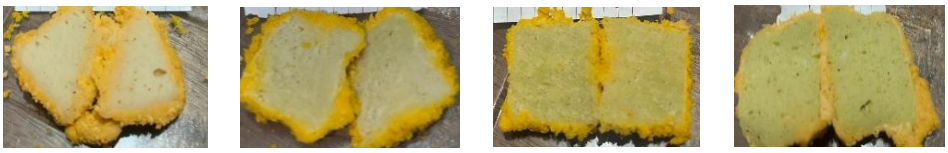
The effect of cooking (fresh and steamed) and the level of vegetable addition on the color b* of chicken nuggets is presented in Table 1. The mean value of vegetable cooking treatment on the color b* of nuggets produced the same value for fresh and steamed vegetables with a value of 22.45. The results of variance analysis for cooking treatment on b* nuggets showed no significant effect (P>0.05).

The average value of the level of vegetable addition to the color b* nugget is the highest at 10% (27.41) and the lowest at 0% (17.03). The variance results for the level of vegetable addition to the b* nugget showed a very significant effect (P<0.01). The increase in yellowness color is due to the content of carotenoid pigments contained in carrot vegetables [12]. In research, Ma'ruf et al. [13] reported an increase in the yellowish color of chicken sausage products combined with carrot flour and wheat flour. The addition of ground carrot and mashed sweet potato had an effect in increasing the redness (a*) and yellowness (b*) values of chicken nuggets [14].

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition on the color of b* nuggets found no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so the LSD further test was carried out to determine the differences in each addition level.

The results of the LSD further test (Table 1) on the level of vegetable addition showed a difference in the yellowness color of the nuggets from the treatment. Based on Table 1, the 30% level of vegetable addition differs from 10% but not from 20%. Then, the 10% level varies from 30% to 20%. Meanwhile, the 0% control treatment differed from all vegetable addition level treatments (10%, 20% and 30%).

4. Sensory Color



0% 10% 20% 30%

The effect of cooking treatment (fresh and steamed) and the additional level of vegetables on the sensory color of nuggets is presented in Table 1. The average value of vegetable cooking treatment on the nugget's organoleptic color was the highest in the addition of steamed vegetables, with a value of 3.69, and the lowest in the addition of fresh vegetables, with a value of 3.61 with greenish yellow nugget criteria. The variance results for cooking treatment on nugget color showed no significant effect ($P>0.05$).

The average value of the vegetable addition level to the highest nugget color is 30% (4.95), with the criteria for a slightly green nugget color, and the lowest is 0% (2.17) with a somewhat pale brown nugget color. The results of variance for the vegetable addition level to the nugget color showed very significant results ($P<0.01$), which means that there is an effect of adding broccoli and carrots to the making of chicken nuggets on the organoleptic properties of nugget color [15]. This is because broccoli and carrots contain pigments that can give color to the product [16].

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition to the organoleptic color of the nuggets found no significant effect ($P>0.05$). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect ($P<0.05$), so the LSD further test was carried out to determine the differences in each addition level.

LSD further test results (Table 1) on the level of vegetable addition showed a difference in the sensory color of the nuggets from the treatment. Based on Table 1, the 10% level of vegetable addition differs from 20% and 30% and vice versa. The 0% treatment is different from all levels of vegetable addition (10%, 20% and 30%).

Organoleptic Quality of Nugget

The organoleptic quality assessment aims to determine panelist acceptance of a product. The results of organoleptic quality research on chicken nuggets with the addition of vegetables and different cooking treatments are presented in Table 2.

Table 2. Organoleptic quality of chicken nuggets with fresh and steamed broccoli (*Brassica oleracea L.*) and carrot (*Daucus carota L.*) vegetables and different addition levels.

Sample	Cooking Treatment	Level of Vegetable Addition (%)				Average
		0	10	20	30	
Aroma	Fresh	3.97±1.06	3.37±0.55	2.37±0.80	2.10±0.71	2.95±1.09
	Steamed	3.97±1.06	3.43±0.67	2.30±0.74	2.03±0.61	2.93±1.12
	Average	**3.97±1.05^{a}**	**3.40±0.61^{b}**	**2.33±0.77^{c}**	**2.07±0.66^{c}**	
Taste	Fresh	3.87±0.77	3.20±0.61	3.27±0.52	1.27±0.44	2.65±1.15
	Steamed	3.87±0.77	3.23±0.56	2.20±0.61	1.33±0.47	2.66±1.12
	Average	**3.87±0.70^{a}**	**3.22±0.58^{b}**	**2.23±0.56^{c}**	**1.30±0.46^{d}**	
Texture	Fresh	2.90±0.80	2.63±0.66	2.33±0.54	2.07±0.58	2.48±0.72
	Steamed	2.90±0.80	2.57±0.77	2.30±0.59	2.00±0.45	2.44±0.74
	Average	**2.90±0.79^{a}**	**2.60±0.71^{ba}**	**2.32±0.56^{cb}**	**2.03±0.52^{c}**	
Hedonic	Fresh	4.30±0.83	4.20±0.66	3.33±0.75	3.33±0.95	3.79±0.92
	Steamed	4.30±0.83	4.23±0.56	3.37±0.76	3.30±1.08	3.80±0.94
	Average	**4.30±0.83^{a}**	**4.22±0.61^{a}**	**3.35±0.75^{b}**	**3.32±1.01^{b}**	

Notes: Different superscripts in the same row indicate significantly different treatments (P<0.05).

1. Aroma

The effect of the cooking treatment (fresh and steamed) and the additional level of vegetables on the aroma of nuggets are presented in Table 2. The average value of vegetable cooking treatment on the organoleptic aroma of nuggets is highest in the treatment of fresh vegetable addition with a value of 2.95 and the lowest in the addition of steamed vegetables with a value of 2.93 with the criteria of slightly meaty aroma nuggets. The variance analysis results for cooking treatment on nugget aroma showed no significant effect (P>0.05).

The average value of the level of vegetable addition to the aroma of nuggets is the highest at 0% (3.97) with the criteria of meaty aroma nuggets and the lowest at 30% (2.07) with the requirements of every unmeaty aroma nuggets. The variance results for the level of vegetable addition to the aroma of nuggets showed a very significant effect (P<0.01). This is due to the impact of using broccoli and carrot vegetables that can reduce the distinctive odor of chicken meat [17] so that the strength and aroma level of the produced chicken meat are covered [18]. Adding broccoli with different levels will affect the aroma of the product [19]. The more broccoli that is added, the more intense the languorous aroma of broccoli will be, reinforced by the fact that the content of broccoli that contributes to giving a distinctive languorous aroma to broccoli is glucosinolate, which contains sulfur [20].

Analysis of variance for the interaction between the cooking treatment and the level of vegetable addition to the aroma of nuggets has shown no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so an LSD further test was carried out to determine the differences in each addition level.

The results of the LSD further test (Table 2) on the level of vegetable addition showed a difference in the aroma of the nuggets from the treatment. Based on Table 2, the 30% level of

vegetable addition differs from 10% but not from 20%. Meanwhile, the 10% treatment differs from the 20% and 30% levels. Then, for the control treatment, 0% is different from all levels of vegetable addition (10%, 20%, and 30%).

2. Taste

The effect of the cooking treatment (fresh and steamed) and the additional level of vegetables on the taste of nuggets are presented in Table 2. The average value of the vegetable cooking treatment on the organoleptic taste of the highest nugget was obtained in the steamed vegetable addition treatment with a value of 2.66 and the lowest in the addition of fresh vegetables with a value of 2.65 with the criteria of nuggets slightly meaty. The variance results for cooking treatment on nugget aroma showed no significant effect ($P>0.05$).

The results of the average value of the level of vegetable addition to the highest nugget taste are 0% (3.87) with meaty taste nugget criteria and the lowest 30% (1.30) with very unmeaty taste nugget criteria. The variance results for the level of vegetable addition to the taste of nuggets showed a significant effect ($P<0.01$). The higher the level of vegetable addition, the more the product's taste will change. This is because broccoli and carrot vegetables taste more dominant than meat [21]. Adding broccoli and carrot vegetables to chicken sausage products produced a slightly vegetable-flavored sausage taste [22].

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition to the nugget taste showed no significant effect ($P>0.05$). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect ($P<0.05$), so the LSD further test was carried out to determine the differences in each addition level.

LSD further test results (Table 2) on the level of vegetable addition showed a difference in the nugget taste. Based on Table 2, the 30% level of vegetable addition differed from 20% and 10%, 20% from 10% and 30%, and 10% from 20% and 30%. Meanwhile, the 0% control treatment differed from all vegetable addition levels (10%, 20% and 30%).

3. Texture

The effect of the cooking treatment (fresh and steamed) and the additional level of vegetables on the texture of nuggets are presented in Table 2. The average value of the treatment of vegetable cooking on the organoleptic texture of the highest was obtained in the treatment of fresh vegetable addition with a value of 2.48 and the lowest in the addition of steamed vegetables with a value of 2.44 with the criteria of non-fibrous and rough nuggets. The variance results for cooking treatment on nugget texture showed no significant effect ($P>0.05$).

The results of the average value of the level of vegetable addition to the texture of the nuggets were the highest at 0% (2.90) with the criteria of slightly fibrous and rough nuggets and the lowest at 30% (2.03) with the requirements of non-fibrous and rough nuggets. The variance analysis results for the level of vegetable addition to the texture of nuggets showed a very significant effect ($P <0.01$). This is due to the high fiber content found in broccoli and carrots, so they can bind water and form a gel so that the produced nuggets will have a soft and smooth texture. This following the findings of Bhasale et al. [15], nuggets added with 15% carrot have the lowest texture value, and the findings of Zargar et al. [23], who reported that fermented sausage products formulated with high levels of DF produced low texture values. A study by Eim et al.

[24] reported that the incorporation of carrot dietary fiber in a mashed meat emulsion resulted in a high order of tissue organization, leading to a stricter texture and high water binding capacity

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition on the texture of the nuggets showed no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so the LSD further test was carried out to determine the differences in each addition level.

The results of the LSD further test (Table 2) on the level of vegetable addition showed a difference in the texture of the nuggets from the treatment. Based on Table 2, the 30% level of vegetable addition differs from 10% but not from 20%. Meanwhile, the 10% level is not different from 20% but different from 30%. Then, for the control treatment, 0% is not different from 10% but different from 20% and 30%.

4. Hedonic

The effect of cooking treatment (fresh and steamed) and the additional level of vegetables on the hedonic value of nuggets are presented in Table 2. The average value of vegetable cooking treatment on the level of hedonic of chicken nuggets is the highest obtained in the treatment of steamed vegetable addition with a value of 3.80 and the lowest in the addition of fresh vegetables with a value of 3.79 with the criteria of like the nugget product. The variance for cooking treatment on the level of nugget hedonic showed no significant effect (P>0.05).

The average value of the level of vegetable addition to the level of nugget hedonic is the highest at 0% (4.30) with the criteria of like and the lowest at 30% (3.32) with the requirements of slightly like the nugget product. The variance results for the level of vegetable addition to the level of nugget hedonic showed a very significant effect (P<0.01). The higher the level of vegetable addition, the less the panelists liked the nuggets [25]. This is because the level of panelist preference is assessed based on a product's color, aroma, taste, and texture [26, 27, 28, 29, 30].

The results of the analysis of variance for the interaction between the cooking treatment and the level of vegetable addition to the level of nugget liking generated that it had no significant effect (P>0.05). The absence of interaction between these two factors means that the cooking treatment does not support each other with the level of vegetable addition. Meanwhile, the level of vegetable addition had a significant effect (P<0.05), so the LSD further test was carried out to determine the differences in each addition level.

The interaction between steaming treatment and added vegetable level was insignificant (P>0.05) on the level of nugget hedonic. This shows that the steaming treatment and the level of vegetable addition do not support each other or are related to the preference level for chicken nuggets.

CONCLUSIONS

Based on the results of this study, the cooking treatment and the level of vegetable addition in chicken nuggets can be concluded that the cooking treatment does not affect the instrument color and organoleptic quality of the nuggets. Meanwhile, the addition level

significantly affects nuggets' instrument color and organoleptic quality. Adding vegetables up to 10% has good physical and organoleptic qualities, which the panelists prefer.

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