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Original Article

DEVELOPMENT CRACKERS OF SHALLOT PEEL FLOUR (*ALLIUM CEPA* L.) SUBSTITUTION

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ABSTRACT

Objective: One of the ingredients of red onion skin (*Allium cepa* L.) is a flavonoid that has the potential to be an antioxidant. Utilization of shallot peel (*Allium cepa* L.) is carried out by making functional food in the form of crackers. The aim of this study were to determine the of flavonoids contents and antioxidant activity in shallot (*Allium cepa* L.) peel flour crackers.

Methods: The method used in this research is a quantitative analysis using the UV-Vis Spectrophotometer instrument at a wavelength of 418 nm for determining contents of flavonoids, and 518 nm for antioxidant activity.

Results: The water and ash content of shallot (*Allium cepa* L.) peel flour was 9.6% and 0.5%. The average percentage of water content crackers of shallot (*Allium cepa* L.) peel flour substitution were 2%, 2.5%, and 3.02%, respectively. The average percentage of acid-insoluble ash content crackers of shallot (*Allium cepa* L.) peel flour substitution were 0.1%, 0.2%, and 0.23%, respectively. The hedonic test results showed respondents liked the aroma, color, and taste of crackers. Shallot (*Allium cepa* L.) peel flour and crackers of shallot (*Allium cepa* L.) peel flour substitution contain positive flavonoid compounds, total flavonoid content of shallot (*Allium cepa* L.) peel flour was 7.160 mgQE/g, and total flavonoid crackers of shallot (*Allium cepa* L.) peel flour substitution were 4.5591 mgQE/g, 4.8719 mgQE/g, and 5.189 mgQE/g respectively. The IC_{50} value of shallots peel flour crackers (*Allium cepa* L.) were 243.45, 224.57, and 206.78 ppm, respectively which are included in the medium level antioxidant.

Conclusion: Shallots peel flour crackers fulfill the SNI standard with a water content were 2.0, 2.5, and 3.02% respectively and the acid-insoluble ash content were 0.1, 0.2, and 0.23% respectively. The shallots (*Allium cepa* L.) peel flour crackers have medium-level antioxidant activity with IC_{50} value were 243.45, 224.57, and 206.78 ppm, respectively.

Keywords: Shallots peel flour, Crackers, Flavonoid levels, Antioxidant activity

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INTRODUCTION

Shallots (*Allium cepa* L.) are native Indonesian spices that have a high selling value in the community [1]. So far, shallots (*Allium cepa* L.) have only been used as a slice of meat, so the peel has the potential to pollute the air and water [2]. This is very unfortunately because the extract of shallot (*Allium cepa* L.) peel contains flavonoid compounds [3], which have the potential to act as antioxidants that can neutralize and prevent damage caused by free radicals to normal cells, polyphenols, saponins, terpenoids and alkaloids [4].

Antioxidants are substances that can ward off or prevent oxidation reactions from free radicals. Excess free radicals can have implications for degenerative diseases, such as heart disease, cancer, atherosclerosis, inflammation, and symptoms of aging [5].

Humans do not have reserves of antioxidants in their bodies, so if there is excessive free radical exposure, the body requires an intake of antioxidants from outside (exogenous). One of them is by consuming artificial antioxidants, both natural, which are processed into functional and synthetic foods that are currently widely circulating in the market [3].

This functional food can be presented in the form of crackers which are expected to be practically carried everywhere and can be consumed by all people because today's consumers tend to expect food products that are fast and practical in their presentation [6].

Crackers are snacks that are often found on the market, have a savory taste, and are served in various compositions so that they can add value to these crackers [7]. One of the added compositions is shallot (*Allium cepa* L.) peel which has been processed into flour first; then crackers are made to substitute shallot (*Allium cepa* L.) peel flour [6].

The aim of this study were to determine the effect of substitution of shallot (*Allium cepa* L.) peel powder on the flavonoid and organoleptic content of shallot peel flour crackers. The benefit obtained from this research is to substitute the raw material for flour in making crackers.

MATERIALS AND METHODS

Plant material

The material used for the study was the peel of shallots (*Allium cepa* L.) obtained from Kebumen, Central Java, Indonesia.

Chemical and reagent

Wheat flour, margarine, yeast, sodium bicarbonate, sugar, skim milk were purchased from cookies store, shallot (*Allium cepa* L.) peel were collected from food mart, water, methanol pro analysis, Mg powder, HCl pro analysis, quercetin standards, $AlCl_3$, potassium acetate, ethanol pro analysis, DPPH (1,1-diphenyl-2-picrylhydrazyl) were purchased from Sigma-Aldrich (Merck KGaA, Missouri, United States), and aquadest were purchased from CV Agung Jaya.

Flour milling method of shallot (*Allium cepa* L.) peel

The peel of shallots (*Allium cepa* L.) is washed under running water and air-dried for about 2 d, then mashed or milled and the sieving process is carried out using 80 mesh flour sieve. The remainder of the sieving is then ground again [8].

Crackers making

Mixing flour, shallot (*Allium cepa* L.), peel flour baking soda, sugar, skim milk, yeast, and water to form a dough, then add margarine stir until a smooth dough forms. The dough is then covered with a napkin, then fermented. Flattening is carried out using a cracker mold with various thicknesses, then printed in uniform sizes and baked at 55 °C for 60 min [6].

Table 1: Crackers formula

Material	Formula I (%)	Formula II (%)	Formula III (%)
Margarine	19	19	19
Yeast	0.7	0.7	0.7
Sodium bicarbonate	0.3	0.3	0.3
Sugar	3	3	3
Skim milk	4	4	4
Wheat flour	37	32	27
Shallot peel flour	5	10	15
Water	31	31	31

Analysis of nutritional content includes water content, acid insoluble ash content [9]. The hedonic test is carried out by giving a score on the parameters of taste, color, and aroma according to SNI 01-2346-2006 [10]. The hedonic test assessment score can be seen in table 2.

Table 2: Hedonic test parameter

Hedonic scale	Numeric scale
Most dislike	0
Dislike	1
Little bit dislike	2
Ordinary	3
Little bit like	4
Like	5
Most like	6

Flavonoid qualitative test

A total of 0.5 g of shallot peel flour (*Allium cepa* L.) and 0.5 g of crushed crackers were put into a different test tube, then dissolved in 1-2 ml of 50% hot methanol, plus Mg powder and HCl concentrated. The results are positive if a red or orange solution is formed [3].

Flavonoid quantitative test

a. Preparation of Quercetin Standard Solution

Prepared a solution 0.01% w/v with ethanol p. a solvent [11].

b. Determination of the λ maximum

Taken 1 ml of 10 µg/ml solution diluted from 0.01% w/v standard solution then added 1 ml of 2% $AlCl_3$, 1 ml of 120 mmol potassium acetate. Incubated the solution for 60 min at room temperature, then measured A at λ 400-450 nm [11].

c. Calibration curve creation

Taken 1 ml of a solution of 6 µg/ml, 8 µg/ml, 10 µg/ml, 12 µg/ml, and 14 µg/ml of the standard 0.01% w/v solution then 1 ml of 2% $AlCl_3$, 1 ml of potassium acetate 120 mmol. Incubated the solution for 60 min at room temperature, then measured A at maximum λ nm [11].

d. Determination of flavonoid levels

The crackers extract was made with a concentration of 0.15% w/v with ethanol p. a solvent, then 1 ml of the pipette of the filtrate was then added 1 ml of 2% $AlCl_3$, 1 ml of 120 mmol potassium acetate. Incubated for 60 min at room temperature, then measured A using the UV-Vis spectrophotometric method at maximum λ, samples were made in three replications for each analysis so that the average value of A was obtained [11].

The content of flavonoids in the sample was determined based on the linear regression of equation y= bx+a [12].

$$flavonoids\ content = \frac{x}{mg\ sampel} \times \frac{vol\ add}{1000\ ml}$$

Antioxidant activity test DPPH method

The test is carried out by piping a number of ethanol extract sample of 500, 1000, 1500, 2000, and 2500 ppm, then adding 1.0 ml DPPH 0.4 mmol and then 5.0 ml of ethanol are sufficient. The solution is allowed to stand for 30 min at room temperature. The absorption was measured with a UV-Vis spectrophotometer at a wavelength of 518 nm. Antioxidant activity is determined from the IC_{50} value [13-15].

RESULTS AND DISCUSSION

Crackers formula

Modification of the composition of the crackers formula needs to get the best results. Changes in the amount of sugar, wheat flour, and shallot peel flour from 7 grams, 100 grams, and 10 grams to 30 grams, 110 grams, and 15 grams. During the trial and error process using an unmodified formula, it was found that the less sweet and less characteristic crackers were made from shallot (*Allium cepa* L.) peel flour. Furthermore, modification of the concentration of sugar, wheat flour, shallot peel flour was carried out [16].

Test of water content and ash content shallot (*Allium cepa* L.) peel flour

This test was carried out to measure the value of the water and ash content in the shallot (*Allium cepa* L.) peel flour. The following table 3 is the data on the results of the water content test and ash content test for shallot (*Allium cepa* L.) peel flour.

The result of shallot (*Allium cepa* L.) peel flour showed that the average of water content and ash content were 9.6% and 0.5% resperctively. The result considerate on SNI 3751:2009 was maximum 14.5% for water content and 0.7% for ash content [17]. Water content on beverages means participate on determination of refreshness and time storage the foodstuff. The high water content cause bacteria, carn and khamir easy to multiply so that there will be changes in foodstuffs. Measurement of ash content aims to find out the amount of mineral content contained in food [18].

Test of water content and acid insoluble ash content crackers shallot (*Allium cepa* L.) peel flour

This test was carried out to measure the value of the water and acid insoluble ash content in the crackers shallot (*Allium cepa* L.) peel flour. The following is the data on the results of the water content test and acid insoluble ash content test for crackers shallot (*Allium cepa* L.) peel flour

Table 3: Result of shallot (*Allium cepa* L.) peel flour analysis

Parameter	Replication			Mean ± SD
	1	2	3	
Water content (%)	9	10	10	9.6±0.58
Ash content (%)	0.6	0.3	0.3	0.5±0.17

Table 4: Result of shallot (*Allium cepa* L.) peel flour crackers water content (%) analysis

Variation	Replication			Mean ± SD
	1	2	3	
5%	2	3	1	2±0.816
10%	2.5	2.75	2.25	2.5±0.204
15%	3	2.85	3.21	3.02±0.148

Table 5: Result of shallot (*Allium cepa* L.) peel flour crackers acid insoluble ash (%) analysis

Variation	Replication			Mean ± SD
	1	2	3	
5%	0.1	0.05	0.15	0.1±0.041
10%	0.1	0.3	0.2	0.2±0.082
15%	0.3	0.2	0.2	0.23±0.047

The results of the test of water content on shallot (*Allium cepa* L.) peel crackers shows an average water content of 2%, 2.5%, and 3.02%, respectively. This result is in accordance with the parameters of SNI 2973:2011, which is not more than 5% [19]. This is obtained because in the manufacture of crackers carried out the roasting process aimed at lowering the water content of crackers to 3-5% [6]. Test results of insoluble ash content of shallot (*Allium cepa* L.) peel crackers obtained an average value of 0.1%, 0,2%, and 0,23%, respectively. This result for variation 10% and 15% is not in accordance with the parameters of RSNI 2973:2018, which is a maximum of 0.1% [20]. Acid insoluble ash content is reflective of the total mineral content of the products [21] and this means that crackers made from the variation of 10% and 15% had higher total mineral content.

Hedonic test of crackers shallot (*Allium cepa* L.) peel flour

This test was conducted to assess the level of acceptance of crackers in the community, especially students of the Department of Pharmaceutical and Food Analysis, Poltekkes Kemenkes Surakarta. The hedonic test carried out included assessment of aroma, color, and taste of shallot (*Allium cepa* L.) peel crackers. The following is the data on the results of hedonic test of shallot (*Allium cepa* L.) peel crackers.

Table 6: Result of hedonic test of shallot (*Allium cepa* L.) peel crackers

Parameter	%							
	Most dislike	Dislike	Little bit dislike	Ordinary	Little bit like	Like	Most like	Total
Colour	0	0	0	30	30	36.67	3.33	100
Odour	0	0	3.33	0	16.67	56.67	23.33	100
Taste	0	0	0	0	16.67	43.33	43.33	100

Hedonic test results or preferred levels were conducted with 30 untrained respondents. Test results for aroma showed that the most dominant respondents chose the impression of likes on shallot (*Allium cepa* L.) peel flour crackers. This is because the smell is a combination of the smell of butter and distinctive shallots. The aroma will affect the favorite level of panelists because it can attract consumers to be interested in shallot (*Allium cepa* L.) peel crackers [22]. Test results for color showed respondents chose the most likes, because the brown color on shallot (*Allium cepa* L.) peel crackers gave the impression of delicious. This is in accordance with the research of [23], which stated that the first thing a person tastes when tasting food, especially food that has not yet been tasted, is how it looks. A person tends to choose foods with an attractive appearance. The savory taste of shallot (*Allium cepa* L.) peel crackers makes respondents choose the impression of likes. Taste is the most important factor to determine the level of liking for crackers successfully received by respondents or not [22].

Qualitative test of flavonoid on flour and crackers from shallot (*Allium cepa* L.) peel

This test was conduct to determine the presence of flavonoid compounds in the flour and crackers from shallot (*Allium cepa* L.) peel. Following are the qualitative test results of flavonoids flour and crackers from shallot (*Allium cepa* L.) peel.

Table 7: Result of flavonoid content test of shallot (*Allium cepa* L.) peel flour and crackers

Type	Colour	Standart
Shallot peel flour	Red	Red or orange
Crackers 5%, 10%, and 15%	Orange	Red or orange

Qualitative test was conducted to find out the presence of flavonoid compounds in the sample of shallot peel flour and crackers, which is presented in table 7. Qualitative test results of flavonoids on shallot (*Allium cepa* L.) peel flour and crackers are proven by the formation of red and orange color in the solution. It is said to be positive contain flavonoids in accordance with the research of [3], which states positive results if a red or orange solution is formed indicating the presence of flavonoids.

Quantitative test of flavonoid on crackers Shallot (*Allium cepa* L.) peel flour

This test was conducted to determine the content of flavonoid content in the crackers shallot (*Allium cepa* L.) peel flour. The following is the data on the quantitative test results of flavonoid content on crackers shallot (*Allium cepa* L.) peel flour:

Table 8: The absorbance of quercetin

Concentration (ppm)	Absorbance
6	0.288
8	0.388
10	0.457
12	0.565
14	0.639

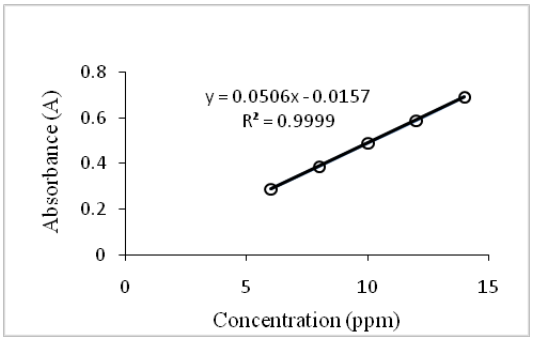

Fig. 1: Calibration curve of quercetin

Determination of flavonoid contents was conducted by UV-Vis Spectrophotometry method due to the presence of conjugated aromatic compounds in flavonoids so as to show a strong absorption tape in the spectrum area of ultraviolet and visible rays [24]. The first step is make series of concentrations of the standard solution because the method used in determining the levels uses the standard curve equation so that linear equations are needed that can be used to calculate the content. The use of quercetin as a standard solution because quercetin is a flavonoid of flavonol group that has keto group in atom C-4 and hydroxyl group in atom C-3 or C-5 neighboring flavon and flavonol [25]. The next step is the measurement of maximum wavelength (λ max) carried out in the range of 400-450 nm, which based on the running results obtained λ max 435 nm, which will later be used to measure the absorbance (A) in the concentration series of standard solutions and samples. The results of absorbance measurement for the standard solution can be seen in table 8 and the calibration curve of the quercetin standard solution can be seen in fig. 1.

Based on the results of these measurements, the higher concentration show the higher the absorbance. Linear regression equation obtained, i. e y = 0.0506x–0.0157. The equation of the calibration curve will be used to determine the total concentration of flavonoid compounds in the sample extract. According to [26] the determination of content by using UV-Vis spectrophotometry used blank solution as a control that serves as a zero maker compound that does not need to be analyzed. The function of adding $AlCl_3$ is as a complex ligand, which is characterized by discoloration of the solution to be yellower, so that the wavelength will shift towards visible, and to maintain the wavelength to remain in the visible area, it is added potassium acetate [27]. Incubation function for 1 hour at room temperature is to maximize the intensity of the resulting color, so that the reaction can run optimally [25]. The average flavonoid total content of shallot (*Allium cepa* L.) peel flour was 7.160 mgQE/g, and crackers of shallot peel flour substitution were 4.5591 mgQE/g, 4.8719 mgQE/g, 5,187 mgQE/g, respectively, that can be seen in table 9. Based on these data, the more addition of shallot peel flour, the higher the total flavonoid contents.

Table 9: Result of flavonoid content test (% w/w)

Type	Replication	Abs	Flavonoid content	
			Total mgQE/g	Mean ± SD mgQE/g
Shallot peel flour	1	0.408	6.359	7.160 ± 0.704
	2	0.490	7.682	
	3	0.475	7.440	
Crackers 5%	1	0.329	4.5417	4.5591 ± 0.0549
	2	0.327	4.5151	
	3	0.335	4.6206	
Crackers 10%	1	0.341	4.7975	4.8719 ± 0.0535
	2	0.339	4.8975	
	3	0.335	4.9207	
Crackers 15%	1	0.343	5.2107	5.189 ± 0.0667
	2	0.340	5.0987	
	3	0,345	5.2576	

Antioxidant activity test

Testing of antioxidant activity by DPPH method based on the reaction of hydrogen capture by DPPH radicals from antioxidants, this process is characterized by the fading color of DPPH solution from purple to yellow, whose absorbance can be measured using a UV-Vis spectrophotometer [15, 28, 29].

Determination of the antioxidant activity of shallots (*Allium cepa* L.) crackers peel flour by the DPPH methods can be determined from the IC_{50} value, namely the concentration of antioxidants that can inhibit 50% of free radicals. IC_{50} values were obtained from linear regression equations by entering crackers concentration data as x values and% inhibition data as Y values [13]. The result of IC_{50} of crackers 5%, 10% and 15% can be seen on table 10, 11, 12 and fig. 2, 3 and 4.

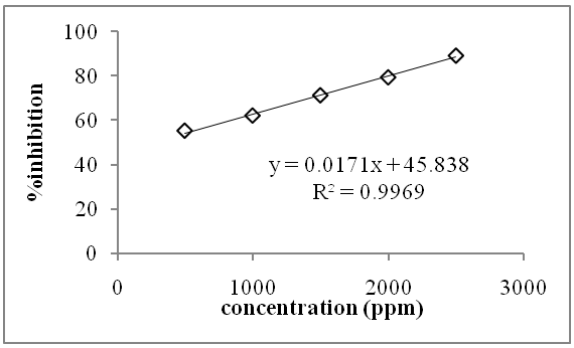

Fig. 2: % inhibition curve of shallots peel flour crackers 5%

Table 10: Result of antioxidant activity of shallot peel flour crackers 5%

Concentration (ppm)	Absorbance of DPPH (control)	Absorbance of sample	% Inhibition	Regresi linier	IC_{50} (ppm)
500	0.771	0.345	55.25	y = 0.0171x+45.837	243.45
1000		0.292	62.13	R^2 = 0.9969	
1500		0.221	71.34		
2000		0.158	79.51		
2500		0.082	89.36		

Table 11: Result of antioxidant activity of shallot peel flour crackers 10%

Concentration (ppm)	Absorbance of DPPH (control)	Absorbance of sample	% Inhibition	Regresi linier	IC_{50} (ppm)
500	0.771	0.340	55.90	y = 0.0175x+46.07	224.57
1000		0.289	62.52	R^2 = 0.9961	
1500		0.218	71.73		
2000		0.147	80.93		
2500		0.074	90.40		

Table 12: Result of antioxidant activity of shallot peel flour crackers 15%

Concentration (ppm)	Absorbance of DPPH (control)	Absorbance of sample	% Inhibition	Regresi linier	IC_{50} (ppm)
500	0.771	0.337	56.29	y =	206.78
1000		0.282	63.42	0.018x+46.278	
1500		0.212	72.50	R^2 = 0.9967	
2000		0.136	82.36		
2500		0.063	91.83		

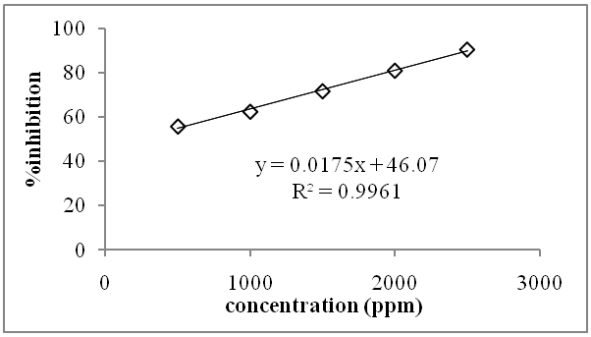

Fig. 3: %inhibition curve of shallots peel flour crackers 10%

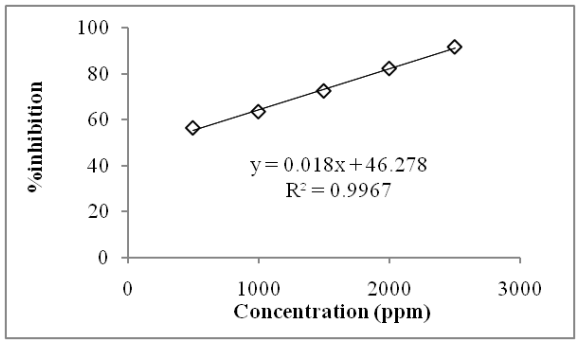

Fig. 4: %inhibition curve of shallots peel flour crackers 15%

Based on table 10, 11, and 12, IC_{50} value of shallots (*Allium cepa* L.) peel flour crackers 5%, 10%, and 15% were 243.45, 224.57, and 206.78 ppm, respectively. Based on these data, the more addition of shallot peel flour, the lower IC50 value of shallots (*Allium cepa* L.) peel flour crackers. It showed that antioxidant activity of shallots (*Allium cepa* L.) peel flour crackers includes on medium level because the antioxidant activity is between 101-250 ppm based on classification antioxidant [30]. The medium-level antioxidant activity possessed by shallots flour crackers (*Allium cepa* L.) is suspected because the compounds contained are flavonoids of the flavonol class. Flavonols generally have medium antioxidant activity. Medium level antioxidant activity of flavonols compounds are generally caused by hydroxyl groups contained in the structure of the compound only a little. So it is most likely to stabilize the structure of compounds that lose electrons from the hydrogen donor process does not occur. Another factor that affects antioxidant activity is the processing process, where antioxidants are easily oxidized and degraded by air and heat. Ingredients that have the potential for an antioxidant activity that are processed with heat and exposed to air directly will damage its chemical content so that it affects antioxidant activity [2].

CONCLUSION

Based on this research can be concluded that the average percentage of water and ash content of shallot (*Allium cepa* L.) peel flour was 9.6% and 0.5%. The average percentage of water content crackers of shallot (*Allium cepa* L.) peel flour substitution was 2%, 2.5%, and 3.02%, respectively. The average percentage of acid-insoluble ash content crackers of shallot (*Allium cepa* L.) peel flour substitution was 0.1%, 0.2%, and 0.23%, respectively. The hedonic test results showed respondents liked the aroma, color, and taste of crackers. Shallot (*Allium cepa* L.) peel flour and crackers of shallot (*Allium cepa* L.) peel flour substitution contain positive flavonoid compounds, total flavonoid content of shallot (*Allium cepa* L.) peel flour was 7.160 mgQE/g, and total flavonoid crackers of shallot (*Allium cepa* L.) peel flour substitution were 4.5591 mgQE/g, 4.8719 mgQE/g, and 5.189 mgQE/g respectively. The IC_{50} value of shallots peel flour substitution crackers (*Allium cepa* L.) were 243.45 ppm, 224.57 ppm, and 206.78 ppm, respectively, which is included in the medium level antioxidant.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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