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In Vitro Protein Digestibility and Physical Properties of Instant Teh Talua Dried by Spray Dryer

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***Abstract*— This study aims to learn the effect of the addition of different concentrations of tea on protein digestibility and physical properties of the product. This study has been completed from February to July 2014. This study begins with the process of making instant teh talua, then continue with product analysis. This study used a completely randomized design (CRD) with 5 treatments and 3 replications. Data were analyzed statistically by F test and if significantly different, followed by Duncan's test New Multiple Range Test (DNMRT) at 5% level. The treatment in this study include A (Without Tea Extract), B (5 g of Tea Extract in 100 ml of water), C (10 g of Tea Extract in 100 ml of water), D (15 g of Tea Extract in 100 ml of water), and E (20 g of Tea Extract in 100 ml of water). The results of this study showed that the addition of treatment between different tea extract gives significant effect on protein content, water-soluble portion, protein digestibility, and no significant effect on moisture content and water activities.**

***Keywords*— Protein digestibility; Instant drinks; Tea; *Teh talua;* Spray dryer**

I. INTRODUCTION

Indonesia is an archipelagic country consist of many tribes. Each region has its own food or drink that can even be a characteristic of the area. Development of the traditional beverage to become more practical to present is needed for conservation of the traditional beverage. One attempt to raise and develop the traditional drink is to make it an instant beverage. Some traditional drinks has made in the form of more practical, both with packaging in the form of ready to drink nor instant powder. An example is bajigur and bandrek, a typical drink from West Java, also teh tarik from Malaysia which has been packaged in the form of instant powder.

Teh talua is a typical drinks from West Sumatra that are categorized of stamina and energy drinks, which are usually served in Padang restaurants [1]. Public perception said that tea can lower the nutritional value of eggs due to the binding of a protein nutritional compounds by tannins contained in tea, mentioned that tannin can bind to proteins and minerals, but tea does not contain tannins, the compound which has been suspected as tannins are katechin. Katechin is a powerful antioxidant and does not damage the protein [2].

Eggs are one of several products produced by birds and is an important commodity in Indonesia. Obtained from an egg perfectly adequate nutrition because it contains complete nutrients such as protein fats, minerals and has a high digestibility. The chemical composition of chicken eggs by Mucthadi [3], composed of water (73.7%), protein (12.9%), fat (11.5%), carbohydrates (0.9%) and ash (1.0%). From this composition, eggs can be processed as variety products with high nutrient content, such as flour, and also as main materials of many products include for drinks.

Tea is produced from tea leaves (Camellia sinensis) which used as a raw material for making beverages. In tea leaves found katechin compound which has several derivatives include catechin (C), gallocatechin (GC), epicatechin (EC), epigallocatechin (EGC), epicatechin-3-gallate (ECG), and epigallocatechin-3-gallate (EGCG) [4]. Six types of katechin compounds above have the ability as different antioxidant compounds. Antioxidant compounds in tea will be higher, when the concentration of the tea is brewed more and more, therefore the extraction of the black tea for 5 minutes with hot water 88 ^{o}C or 93 ^{o}C for 3 minutes, will produce optimal extraction so that in this condition throughout the caffeine and katechin in the tea will be extract [5]. This will lead to the high content of antioxidants in the drinks made from tea such as instant tea, teh tarik, and also teh talua.

Instant teh talua powder will be one of product diversification from tea, which made by using a spray dryer.

II. Material and Method

The raw materials in this study is the chicken eggs that are not older than 1 week, derived from chicken farms in Kenagarian Padang Koto Tuo Mungka, Mungka, Lima Puluh Kota regency. Another ingredient of black tea brands Kadjoe Aro, other additives such as sucrose, and vanilla powder, citric acid from citrus acid, as the addition in mixing eggs, and maltodextrin are used as filler material obtained from the store chemicals, further chemicals to analysis used as distilled water, N-hexane, concentrated H_2SO_4, H_3BO_3, NaOH, HCl, multi-enzyme solution, and the solution of DPPH.

The equipment's used for this study are mixer, glass, filter cloth, spray dryer Bu-chi B-290, filter paper, and chemical analysis tools, namely; beaker, measuring cups, test tube, digital scales, spectrophotometry UV-VIS, tweezers, kjehdahl pumpkin, pumpkin soxhlet, autoclave, oven, tannur, water bath, pH meter, burette, pipette, Aw meter, and thermometer.

A. Research Design

This research use Completely Randomized Design (CRD) with five treatments and three replications. Treatments in this study are based on Susanto [6] as follows:

- A (0 g / 100 ml water) = Without Tea Extract
- B (5 g / 100 ml water) = 5 g of Tea Extract in 100 ml of water
- C (10 g / 100 ml water) = 10 g of Tea Extract in 100 ml of water
- D (15g / 100 ml water) = 15 g of Tea Extract in 100 ml of water
- E (20 g / 100 ml water) = 20 g of Tea Extract in 100 ml of water

TABLE I
FORMULATIONS OF MAKING INSTANT TEH TALUA

No	Materials	A	B	C	D	E
1	Tea : Water (g/ml)	0/100	5/100	10 /100	15 /100	20/100
2	Egg yolk (g)	10	10	10	10	10
3	Citric acid (%)a	1,6	1,6	1,6	1,6	1,6
4	Maltodextrin (%)b	10	10	10	10	10
5	Vanilla powder (%)b	0,08	0,08	0,08	0,08	0,08
6	Sukrose (%)c	100	100	100	100	100

Note : a) percentage from egg yolk weight, b) percentage from (ml) tea extract , c) percentage from dry weight of instant teh talua

B. Implementation

1). Tea Extraction [6]

Black tea powder is weighed according to treatment (5, 10, 15, 20 grams). Furthermore, brewed using 100 ml of hot water 90 ^oC for 5 minutes. Materials that have been brewed continued with squeezed (pressing) and filtered. The filtrate was placed into a container for use on the next step.

2). Mixing Yolk Egg

The yolk is taken and homogenised then weighed 10 grams, put in a container with addition 1,6% of citric acid, and mix egg yolks for 6 minutes until it white-foamed, using a hand mixer, speed 1 to 5 gradually on a scale speed mixer.

3). Making Instant Teh Talua

Hot tea extract that has been made mixed in the heat treatment temperature (85-90 ^oC) into the egg foam, then stir it and add maltodextrin 10%, do homogenization with a homogenizer, then dry the solution using a spray dryer with a temperature inlet 150 ^oC and outlet 58 ^oC. Teh talua powder are formed, added sugar 100% from the dry weight of the powder, then do the mixing and stirring. The products are prduced, do test and analysis in accordance with the observations that will be done.

C. Observation

The observations in this research are the analysis of instant teh talua include: moisture content [7], protein content [7], protein digestibility [8], and physical properties include water-insoluble portion [7] and water activity [7].

III. Results and Discussion

A. Moisture Content and Protein Content

The following data is analysis result on water content and protein content of instant teh talua present in Table II:

TABLE II
MOISTURE CONTENT AND PROTEIN CONTENT OF INSTANT TEH TALUA

Treatments	Moisture Content (%)	Protein Content (%)
E	3,04 ± 0,16a	8,08 ± 0,02a
D	4,33 ± 0.48b	8,62 ± 0,63a
C	4,54 ± 0,38b	8,95 ± 0,81a
B	4,58 ± 0,05b	10,63 ± 0,75b
A	4,71 ± 0.37b	10,89 ± 0,35b
CV	7,95%	6,28 %

The numbers in the same column followed by the same lowercase letter are not significantly different according to DNMRT at 5% significance level .

Moisture content of product ranged from 3.04%-4.71%. The higher concentration of tea given cause moisture levels also increased, this can be caused by the presence of bound water contained in tea components such as carbohydrates, and amino acids, the higher concentration of tea extract the higher portion which are not soluble in water so that the percentage of total dissolved solids reduce, causing evaporation in a spray dryer will be disrupted. Based on SNI 01-4320-19969, the value of moisture content for the quality requirements of traditional instant drink powder is a maximum of 3%. Where the content of the water content ranged from 3.04% - 4.71% on instant teh talua showed that the water content of the product of this research still does not meet the requirements set by SNI 01-4320-19969.

Protein content of instant teh talua based on Table 2 above on treatment B, C, and D, chronologically an increase protein levels with a peak in treatment B (Extraction 15 g of tea in 100 ml of water) that is equal to 10.63%, while in treatment E (Extraction 20 g of tea in 100 ml of water) protein levels declined, but this reduction was not significantly different with treatment B and C, the protein levels decrease back on treatment E, allegedly due to the high concentration of tea is 20%, also contains the higher polyphenols, possibly at this concentration has a stronger

interaction between polyphenols of tea with egg protein causes agglomeration, so that when the spray dryer drying with this blob reduce the percentage of dissolved solids, it causes droplets that are sprayed into the drying chamber can not be perfectly dry, so a lot of sediment on the wall and fell to the drying chamber base. According to Buxter et al [10] said that the food protein interactions with polyphenols form a complex which can lead to colloidal and cause cloudiness in beverages. Polyphenols that interact with a protein can also cause changes in the structure and conformation of the protein, which indicates that the binding affinity depends on the molecule of polyphenols, which at higher molecule the greater complexes form that tend with proteins [10].

A. Analysis of In Vitro Protein Digestibility

The result of analysis on protein digestibility of instant teh talua is presented in Table 3:

TABLE III
PROTEIN DIGESTIBILITY OF INSTANT TEH TALUA

Treatments	Protein Digestibility (%)
E	0,39 ± 0,01a
D	3,41 ± 1,47a
C	8,49 ± 0,54b
B	16,25 ± 2,24c
A	48,26 ± 1,64d
CV	9,27 %

The numbers in the same column followed by the same lowercase letter are not significantly different according to DNMRT at 5% significance level .

From the analysis of variance known that the addition of different concentrations of tea extract gives significant effect ($P < 0.05$) on in-vitro protein digestibility. The data show that with the increasing concentration of tea extract, causing a decline in egg protein digestibility. The decrease in protein digestibility possibly because of the interaction between polyphenols of tea with proteins resulting impenetrable protein by digestive enzymes, due the changes in the structure of the target enzyme substrate [11].

Based on the research by Shen et al., 2014 [8], to the egg protein digestibility were added with polyphenols, shows that a decline in digestibility of egg protein by enzyme pankreatin, this is caused by the interaction between polyphenols with proteins that result in non-covalent binding of proteins changed, by using FTIR spectroscopic. Shen, et al [8] showed that a formation in the structure of α-helix and β-sheet of the protein, which when added polyphenols occurs rise structure α-helix and β-sheet structure is decline, it caused a change in the secondary structure of the protein becomes more compact and difficult to penetrate by the digestive enzymes

B. Physical Properties

Here are the results of analysis of water activity and water-insoluble portion of the product:

TABLE IV
WATER ACTIVITY AND WATER-INSOLUBLE PORTION OF INSTANT TEH TALUA

Treatments	Water Activity (Aw)	Part Insoluble (%)
A	0,461 ± 0,03a	24,44 ± 1,62a
E	0,532 ± 0,02b	27,97 ± 2,81a
D	0,535 ± 0,01b	38,61 ± 6,81b
C	0,538 ± 0,03b	39,00 ± 3,65b
B	0,565 ± 0,04b	42,80 ± 9,67b
CV	5,37 %	16,56 %

The numbers in the same column followed by the same lowercase letter are not significantly different according to DNMRT at 5% significance level

From the analysis of variance showed that among the treatments provide significant effect ($P < 0.05$) to the water activity of instant teh talua that produced, but when compared between treatment B, C, D, and E are not significantly different between the one with the the other, it shows that the addition of different concentrations of tea does not give significant effect on water activity of the products. Generally, the values of water activity are very low, it makes the growth of microorganisms in product relatively small. According to Winarno [12], molds and yeasts begin to grow at water activity 0.7 to 0.8, while the growth of bacteria occurs if water activity reaches 0.8.

The addition of different concentrations of tea gives significant effect on the water-insoluble portion. Analisys results of water-insoluble portion ranged 24.44% - 42.80%. Water-insoluble portion increased along with the increase in the concentration of tea extract that given, this can be due to high crude fiber content in tea, according to Nasution and Tjiptadi [13], crude fiber content of black tea reached 34%.

IV. CONCLUSIONS

Based on the research that has been done can be concluded as follows: The addition of different tea extracts on egg instant tea products significantly affected protein content, protein digestibility, and water-insoluble portion. Based on the analysis of in-vitro protein digestibility, showed that with the addition of tea to egg, can decrease the digestibility of egg protein.

Based on the research that has been conducted, the authors suggest that reducing the mixing of eggs with tea at the tea concentration is too high because it can decrease the digestibility of egg protein. To the next researcher, author suggested to conduct further research on more evaluation of the amino acid profile of tea egg proteins that interact with tea polyphenols, and also in-vivo nutritional value.

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