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Quality Analysis of Fresh Vegetable Product with Prima Certificate (Case Study of Nagari Padang Lua Kecamatan Banuhampu Kabupaten Agam)

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A B S T R A C T

According to the Indonesian National Standard (SNI), fresh food quality parameters must have specific physical quality criteria and be free from pesticide residues, microbial contamination, and heavy metal contamination. The purpose of the study was to analyse the quality of red chilli peppers, spring onions, cabbage, eggplant, and chickpeas that have been certified prima with 3 (three) testing parameters, namely testing the physical quality of vegetables referring to SNI 01-4480-1998 for red chilli products, SNI 01-6996-2004 for spring onion products, SNI 01-3174: 1992 for cabbage products, SNI 3163: 2014 for purple eggplant and chickpea products. Lead heavy metal contamination testing refers to SNI 7387:2009, and microbiological contamination testing refers to SNI 7388:2009. The research was conducted in the Nagari Padang Lua area, Kecamatan Banuhampu, Kabupaten Agam, on five vegetable cultivation businesses that have been certified as prima. The research method used was descriptive testing. The results showed that there were deviations in the physical quality of fresh red chillies, namely the level of uniformity of the size of red chillies that were below the SNI quality standard (92.33%), very high levels of impurities in leaf onions, total microbial contamination (ALT) in leaf onions and cabbage/cabbage exceeded the maximum limit of total contamination allowed in food, namely 1.39x104 and 1.708x104 E.Coli contamination was detected exceeding the maximum limit of contamination in chickpeas which was 3/gr. In contrast, for lead contamination (P4), the total microbial contamination (ALT) in leaf onions and cabbage exceeded the maximum limit of total contamination allowed in food, respectively.

1. INTRODUCTION

1.1. Research Background

Fresh food has a shorter shelf life than processed food products. It often must be stored and consumed quickly to avoid a decrease in product quality due to damage and contamination by various physical, chemical, and biological contaminants. So, fresh food products require special efforts to maintain quality conditions when consumed [1].

Food is part of human rights, and to achieve this, it is necessary to organise a food system that can protect both those who produce and consume food to realise the implementation of food safety that can meet food that is safe for the health and safety of the lives of all Indonesian people [2].

Prima certification is a fresh food quality control measure that involves testing, inspection, and verification of fresh food quality by certification bodies. This aims to ensure that fresh food products sold to consumers meet the required quality standards to be safe for consumption. Meanwhile, prima certification in West Sumatra still has weaknesses, namely, the issuance of prima certificates only needs to pass the pesticide residue test to be declared safe for consumption, while referring to the Indonesian National Standard (SNI), fresh food quality parameters must have certain physical quality criteria, free from pesticide residues, microbial contamination and free of heavy metal contamination. Therefore, it is necessary to study the extent to which the implementation of prima certification of horticultural products, especially for vegetable products, can provide product quality assurance in terms of physical, chemical and biological quality by conducting laboratory testing.

1.2. Literature Review

Food quality is the value determined based on food safety criteria, nutritional content, and trade standards for food, food and

beverage ingredients [2]. Quality is a collection of properties or characteristics of materials/products that reflect consumer acceptance of these materials [3]. Food quality can also be defined as the conditions and efforts needed to prevent food from possibly biological, chemical and other contaminants that can interfere with, harm and endanger human health [4]. To ensure food quality, food safety must be implemented along the food chain, starting from the stages of production (cultivation), harvesting, processing, storage, distribution, and circulation to reach consumers [5].[8].

The fresh food quality requirements set by the Indonesian National Standard (SNI) regulate the maximum limit of heavy metal and microbial contamination and several criteria for the physical quality requirements of fresh food.

Table 1. Maximum Limit of Heavy Metal Contamination in Vegetables and Fruit (SNI Number 7387: 2009)

No	Heavy Metal Contaminants	Maximum Limit of Contamination
1	Arsenic (As)	1.0 mg/kg
2	Cadmium (Cd)	0.2 mg/kg
3	Mercury (Hg)	0.03 mg/kg
4	Lead (Pb)	0.5 mg/kg

Source: [2]

Table 2. Maximum Limit of Microbial Contaminants (SNI Number 7388:2009)

No	Microbial Contamination	Maximum Limit of Contamination
1	Fresh fruit	
	- APM E. Coli	< 20/g
	- Salmonella sp	Negative/25 g
2	Fresh vegetable	
	- APM E. Coli	< 3/g
	- Salmonella sp	Negative/25 g

Source: [3]

Table 3. Physical Quality Requirement of Vegetable

No	Product	Quality Standardization
1	Red Chili (*Capsicum annum*)	SNI 01-4480-1998
2	Leek (*Allium fistulosum*)	SNI 01-6996-2004
3	Cabbage (*Brassica oleracea var. capitata*)	SNI 01-3174:1992
4	Eggplant (*Solanum melongena*)	SNI 3163:2014
5	Chickpeas (*Phaseolus vulgaris*)	SNI 3163:2014

(Source: National Standardization)

1.2.1. Prima Certification of Fresh Food

The prima certification program is the implementation of fresh food supervision activities carried out on fresh food in the production process (On Farm) to minimize problems that arise during the production process. The economic and welfare aspects of farmers are not explicitly included in the definition of prime certification. Still, the purpose of prime certification is explicitly to increase optimal crop yields in quantity and quality. The prima certification program is expected to generate value for consumers and added value for producers (farmers).

The Directorate General of Processing and Marketing of Agricultural Products, Ministry of Agriculture, in the "General Guidelines for the Use of the Prima Label" (2007), regulates the use of the prima logo on fresh food products that have been certified prima which are divided into three categories:

- **Prima 3** means the product is safe for consumption (safe from pesticides).
- **Prima 2** means that the product is safe for consumption (safe from pesticides) and of good quality (there is grading).
- **Prima 1** means that the products produced are safe for consumption (pesticide safe), quality and environmentally friendly, and internationally accredited.

Prima 1 Prima 2 Prima 3

Fig 1. Prima certificate logo

1.3. Research Objective

The study aimed to analyze the quality of prima-certified vegetable products with 3 (three) testing parameters: testing the physical quality of vegetables, testing for lead heavy metal contamination, and testing for microbiological contamination.

2. MATERIALS AND METHODS

2.1. Data Type of Research

Conduct sampling for testing using the probability sampling method. Samples are taken from vegetable cultivation fields. The population's size determines the sample size to be taken with a reference that has been regulated about the procedures for taking samples [6]. Then, laboratory testing with descriptive methods is carried out on 3 (three) quality parameters, namely physical quality parameters of vegetables, microbial contamination levels and lead (Pb) contamination levels; then, the test results are compared with the SNI of each vegetable product.

2.2. Analysis

All parameters in this study were carried out in 3 replicates by calculating the percentage of damaged/rotten vegetables, the level of impurities in the sample, measuring the length of the fruit, and visual quality test. The lead heavy metal contamination test was carried out using the *Atomic Absorption Spectrophotometer* (AAS) method. The microbial contamination test was by counting the total bacterial colonies in the sample using *Sodium Agar* (NA) media, *Salmonella, sp* content testing using *Lactode Broth* (LB), *Tetrathionate Broth* (TTB), *Rappaport Vassiliadis* (RV) and *Bismuth Sulfite Agar* (BSA) media. For testing the content of *E.coli* bacteria using *Lactode Broth* (LB), *Brilliant Green Lactose Broth Bile (BGLB),* and *Eosin Methylene Blue Agar* (EMBA) media.

2.3. Procedure of Research

Data analysis was carried out using the following methods.

1. Percentage of Damaged/Rotten and Percentage of Impurities in Samples.
   a. Weigh the entire sample (x), observe each sample, separate the damaged and rotten, and then weigh them as (y).

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b. To test the level of dirt in the sample, observe other objects included in the term dirt, such as twigs, leaves, and other objects, and weigh them as (z).
Damaged/rotten weigh (%) (w/b) = $\frac{y}{x}$ x 100%
Dirt content weight (%) (w/b) = $\frac{z}{x}$ x 100%
c. The results obtained were then compared with the standard.
d. A visual test is carried out and compared with the standard for the uniformity test of variety, shape, size and color.

2. Measure Length Test
Fruit length was measured using a furnicaliper from the tip of the fruit to the base of the stalk, and then it was separated according to the classification provisions stated in the standard.

3. Lead (Pb) Level Test Referring to SNI 01-2896-1998
The test was conducted using an *Atomic Absorbtion Spectrophotometry* (AAS) instrument. The dried sample was weighed as much as 2 grams and then ground until smooth and sieved using a 100 mesh sieve. Added 100 ml of distilled water and 5 ml of 65% HNO_3, the sample was deconstructed using an electric stove until the solution was clear ± 20 ml, filtered using Whatman filter paper, then compressed with distilled water to 25 ml and then tested using an AAS. The working principle of AAS is the absorption of light by atoms. Atoms absorb light at specific wavelengths, according to the nature of the element. The test results will then be compared with the standard.

4. Microbial Contamination Test Referring to SNI 19-2897-92
a. Bacterial colony count testing method with Total Plate Count (TPC)
1) Weigh the vegetable samples using an o'haus balance of as much as 5 grams each. Then, soak using distilled water solution for 1 hour.
2) Take 1 ml of soaking water and dilute it 3 times.
3) Take water from each dilution, as much as 1 ml, using a micropipette and put it into a Petri dish, followed by pouring *Natrium Agar* media.
4) Homogenized by making a figure-eight movement. Then, it is incubated in an incubator at room temperature (37ºC) for 48 hours.
5) Observe the results by counting the bacterial colonies using direct observation.

Dilution Factor = Dilution x number planted.
Colony count = Number of colonies/dish x $\frac{1\ldots}{\text{dilution factor}}$
(CFU/g)

b. *Salmonella sp* test method
1) Weigh the sample as much as 25 grams, then put it in a sterile container. Add 225 mL of *Lactode Broth* (LB) solution to the sample sterile container. Then, homogenize until the solution becomes homogeneous.
2) Transfer the suspension into an Erlenmeyer flask, then incubate at 35ºC for 24 hours + 2 hours.
3) Take and transfer 1 mL each into a test tube containing 10 mL of *Tetrathionate Broth* (TTB) media and 0.1 mL into a test tube containing 10 mL of *Rappaport Vassiliadis* (RV) media.
4) Incubate RV media samples at 42ºC + 0.2ºC for 24 hours + 2 hours. For TTB media, samples are incubated at 35ºC + 2ºC for 24 hours + 2 hours.
5) Perform the isolation stage in laminar air flow, take two or more colonies with an ose needle from each incubated media, and inoculate *Bismuth Sulfite Agar* (BSA) media in a petri dish.
6) Incubate at 35ºC for 24 hours + 2 hours. Suspected salmonella colonies formed on BSA media are greyish or blackish, sometimes metallic, around brown colonies, and the longer the incubation time will turn black. If no such color is formed, the test is negative for *salmonella, Sp.*

c. *E.Coli* bacteria test method
1) Take 1 ml of sample soaking water and dilute it 3 times.
2) Take 1 ml of water from each dilution using a micropipette and put it in a test tube containing 9 ml of *Lactode Broth* (LB) media. LB media is a source of carbohydrates for bacterial fermentation.
3) Incubate all dilutions in LB media at 37ºC for 24 - 48 hours ± 2 hours in an incubator.
4) Interpretation of positive test results if they show turbidity and the appearance of gas in the Durham tube.
5) Confirmation test: Take 1 dose of the gas-forming sample and put it into each tube that already contains 4 ml of Brilliant *Green Lactose Broth Bile* (BGLB) according to the level of dilution in the previous test tube. BGLB media can inhibit the growth of bacteria other than Coliform types.
6) Incubate the test tube at 370C for 2x24 hours. Positive results if gas forms in the tube.
7) To count the colonies of E.coli bacteria, it is necessary to culture in agar media by taking 1 dose of a positive sample and incubating it in a petri dish containing EMBA.
8) Incubate at 37^0C for 2x24 hours,
9) Observe the results by counting the bacterial colonies using direct observation. Suspected E.coli colonies formed on *Eosin Methylene Blue Agar* (EMBA) media are metallic green.

3. RESULT AND DUSCUSSION

3.1. Physical Quality

The results of physical quality testing of prime certified vegetables in Nagari Padang Lua Kecamatan Banuhampu West Sumatra are presented in Table 4.

The average red chilli fruit size uniformity test result of 92.33% is below the SNI quality standard; according to SNI, the level of uniformity of good quality red chilli is 98% for quality I, 96% for quality II and 95% for quality III. The results of the physical quality test of leaf onions show an average leaf ageing percentage of 98.67%, while in SNI, the physical quality requirements of the product must have a uniform ageing level (100%); the test of dirt content on leaf onions also does not meet SNI quality standards due to high dirt levels in the root part of the leaf onion. The weight of cabbage shows a varied weight, which is an average of 96%, while the SNI quality standard stipulates that the quality requirements for good cabbage weight are 100%. The physical

quality test of eggplant and chickpea vegetable products is still within the SNI quality standards. The results of the physical quality test of vegetables illustrate that even though they are certified prime, the physical quality conditions of vegetable products still vary.

Table 4. Physical Quality Test

No	Test Type	Unit	Test result	Quality class
Red Chili (*Capsicum annum*)				
1	Color	%	Red (95.67) ± 1.15	Class I
2	Shape	%	uniform (96) ± 1	Class II
3	**Size**	%	92.33 ± 2.08 abnormal	Under standard
4	Length	cm	8.33 ± 1.53	Class III
5	Impurity	%	2.33 ± 0.57	Class III
6	Level of damage	%	2	Class III
Leek (*Allium fistulosum*)				
1	Ageing level	%	98.67 ± 1.15	Under standard
2	Freshness	%	100	Class A/B
3	Size	%	91.33 ± 1.15	Class B
4	Impurity	%	Dirty root	Under standard
5	Extent of Damage	%	0	Class A/B
Cabbage (*Brassica oleracea var. capital*)				
1	Variety	-	Uniform	Class I/II
2	Weight size	%	96 ± 1.73	Under standard
3	Density	-	Solid	Class I
4	Outer leaf colour	-	Greenish and fresh	Class I/II
5	Size diversity	%	90.67 ± 1.41	Class II
6	Impurity (b/b)	%	0	Class I/II
7	Extent of Damage	%	4.33 ± 0.58	Class II
Eggplant (*Solanum melongena*) :				
1	Variety	-	Uniform	Class I/II
2	Density	-	Less density	Class II
3	Fruit color	-	Normal	Class I/II
4	Skin Surface	-	Flat	Class II
5	Texture		No wilting	Class I/II
6	Impurity	%	8.67 ± 1.15	Class II
Chickpeas (*Phaseolus vulgaris*)				
1	Variety	-	Uniform	Class I/II
2	Density	-	Less density	Class II
3	Fruit color	-	Normal	Class I/II
4	Skin Surface	-	Flat	Class II
5	Texture		No wilting	Class I/II
6	Impurity	%	8.33 ± 1.53	Class II

(Source: Processed data)

3.2. Chemical Quality

Chemical quality test by testing for lead (Pb) heavy metal contamination in vegetables is presented in Table 5.

Table 5. Chemical Quality Test

No	Kind of vegetable	Test result (Pb) average (mg/kg)	Information
1	Red Chili (*Capsicum annum*)	0,084 ± 0.13	Qualified
2	Leek (*Allium fistulosum*)	0,059 ± 1,65	Qualified
3	Cabbage (*Brassica oleracea var. capital*)	0,047 ± 3,25	Qualified
4	Eggplant (*Solanum melongena*)	0,075 ± 0,89	Qualified
5	Chickpeas (*Phaseolus vulgaris*)	0,094 ± 1,51	Qualified

(Source: Processed data)

Lead (Pb) pollution levels from the test results still meet the quality requirements because they are below the maximum allowable pollution standards. The maximum level of lead heavy metal contamination in vegetables regulated in SNI No. 7387-2009 is 0.5 mg/kg, and even so, Pb contamination levels are still detected. The possible source of Pb contamination in vegetable products is due to the use of fertilizers, especially P (phosphorus) fertilizers, which, in addition to containing primary nutrients (P_2O_5), secondary nutrients (Ca and Mg), and micronutrients (Fe, Mn, Cu, and Zn) also contain heavy metal elements. P fertilizers used in agricultural cultivation can cause soil pollution because they contain heavy metals [2]. The source of Pb pollution in vegetable products can also come from the air. Pb's concentration in the air can occur due to vehicle traffic activities along the study site [6].

3.3. Biological Quality

Table 6 presents the results of the biological quality test, which tested the total microbial contamination levels in vegetable products, E. Coli contamination levels, and Salmonella sp.

The results of the vegetable contamination test above show that green onions and cabbage have levels of total microbial contamination (ALT) higher than the maximum limit of total contamination allowed in food, which is 1.39 x 104 and 1.708 x 104, respectively, by the decision of the Directorate General of POM RI No. 03725 / B / SK / VII / 1990 concerning the Maximum Limit of Microbial Contamination in food is 103 cells / g, then detected E. Coli contamination of 3 / g in chickpeas. There is the possibility that the source of contamination comes from polluted water used for watering plants or from compost derived from livestock manure, as well as unhygienic post-harvest handling [7].

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Table 6. Biological quality test results

No	Kind of vegetable	Test result (Pb) average (mg/kg)	Information
1	Cabai merah (*Capsinum annum*)		
	Amount of Mikroba	1.96 x10^3 ± 1.18	Qualified
	APM E.Coli	1.33/gr ± 0.58	Qualified
	Salmonella sp	(-)	Qualified
2	Bawang Daun (*Allium fistulosum*)		
	Amount of Mikroba	1.39 x10^4 ± 0.03	Not Qualified
	APM E.Coli	2.67/gr ± 1.53	Qualified
	Salmonella sp	(-)	Qualified
3	Kol / Kubis (*Brassica oleracea var. capitata*)		
	Amount of Mikroba	1.708 x10^4 ± 0.04	Not Qualified
	APM E.Coli	2/gr ± 1	Qualified
	Salmonella sp	(-)	Qualified
4	Terung (*Solanum melongena*)		
	Amount of Mikroba	1.37 x10^3 ± 0.62	Qualified
	APM E.Coli	1.33/gr ± 0.58	Qualified
	Salmonella sp	(-)	Qualified
5	Buncis (*Phaseolus vulgaris*)		
	Amount of Mikroba	4.85 x10^3 ± 0.02	Qualified
	APM E.Coli	3/gr ± 1	Not Qualified
	Salmonella sp	(-)	Qualified

(Source: Processed data)

4. CONCLUSION

The results of testing the quality of prime certified fresh vegetables show that there are physical quality deviations in red chillies, namely the level of uniformity of the size of red chillies that is below the SNI quality standard (92.33%) and very high levels of dirt in leaf onions. Total microbial contamination (ALT) in leaf onions and cabbage exceeds the maximum limit of total contamination allowed in food, which is 1.39x104 and 1.708 x 104, respectively; E. Coli contamination was detected exceeding the maximum limit of contamination in chickpeas, which is 3/gr, while for lead contamination (Pb) it is still below the maximum limit of contamination allowed in fresh vegetables.

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