

# Perception, Attitude and Factors Influencing Household's Acceptance to Transgenic Late Blight Resistant Potatoes

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## Abstract

The objective of this study was to identify the perception, attitude and factors influencing the household's acceptance to the transgenic late blight resistant potatoes. The research used data taken from 101 respondents in Bandung West Java, Indonesia from September to November 2009 using stratified random sampling. The surveys showed that most of the respondents (99%) never heard about transgenic potatoes. About 36% respondents said that transgenic potatoes were safe to be consumed. At least, 55.4% respondents were willing to consume transgenic potato as long as there was no negative effect by consuming it. In addition, 44.6% respondents said that they were not willing to consume the potato because they did not know it. Result of Chi-square test showed that the most factors influencing household acceptance to transgenic potato were consumption frequency and consumers' potato criteria. Statistical analysis using logit binomial test showed that education and consumers' potato criteria were the most important factors for the household to accept the transgenic late blight resistant potatoes.

*Keywords: consumers' acceptance, consumers' attitude, potato transgenic*

## Introduction

Potato is the fourth source of carbohydrate in the world and has a big chance as an alternative food diversification because it contains high nutrient. Potato production centers in Indonesia commonly locate in high land, with high rainfall and humidity. The condition is very suitable for late blight (*Phytophthora infestans*-Mont de Barry disease). Yield loss caused by diseases reached 60 to 80% (Wattimena, 1994). In severe attacked, the loss reached 100%.

The development of resistant potato varieties are one of the solution to reduce yield loss caused by late blight disease. Several sources of potato resistant to late blight have been found in some species of wild potatoes such as *S. demissum*, *S. bulbocastanum*, *S. stoloniferum*, and *S. microdontum* (Hawkes, 1994). Resistant genes to the late blight from *S. bulbocastanum* have been cloned and used to produce potato resistant late blight. The crossing between Katahdin Rb with Granola and Atlantik resulted in resistant filial to late blight (Song *et al.*, 2003). In 2004, trial to Katahdin transgenic potatoes was conducted. The results showed that Katahdin could control late blight at the *early-season*. Field trail to examine potatoes resistant characteristic was held in 2007 and 2008 and several filials (F1) resistant to late blight infection.

Kotler and Susanto (2001) reported that several factors influence consumer behavior, including psychology. Psychology aspects involve perception, knowledge, and attitudes become important aspects in consumer acceptance to the product. Study on consumer behavior to the transgenic products has been conducted in some countries. The consumer acceptance to the transgenic products depends on their perception to the benefit and the risk of the transgenic (Byrne, 2006). Supporting of transgenic products come from United State of America and Japan consumers in agriculture and healthy sectors. The more information consumers get, the more positive response give to transgenic crops (Hoban, 1999). Other studies showed that respondents' knowledge related

to transgenic crops and labeling has a negative impact to consumer acceptance (Jill *et al.*, 2001). In Korea, the consumers tend to reject transgenic food, especially women, people who get high education and persons who have enough information about transgenic (Onyango *et al.*, 2004).

In Indonesia, the issue about transgenic crops is still in debates. Pros and cons emerge as the development of transgenic information and the willingness to plant the products with several reasons. Studies to observe factors influencing household acceptances' to transgenic crops has been done in three big cities in Indonesia, i.e. DKI Jakarta, East Java and North Sumatra concluded that the less information about transgenic crops consumers have, the easier for consumers to accept transgenic food. Meanwhile, in economic term, consumers from middle and higher economic strata are more willing to accept transgenic crops than the consumer from lower economic. Public acceptance to transgenic crops are also influenced by direct and indirect risk perception from transgenic food, benefit, risk and the credibility of policy institution in evaluating safety crops and the environment (Riska, 2009).

Issues on pros and cons about transgenic crops in Indonesia developing bigger than the product itself. The opponent was greater seen from media coverage rise out the negative effect of transgenic crops and it will affect consumer acceptances' to the transgenic potatoes. In fact, the product has not been released and sole in Indonesia. The commercialization of transgenic potatoes shall go through several trial tests in advance such as limited testing of varieties, limited testing laboratories (bio safety containment) and limited field test (bio safety confinement) based on Bio safety Commission regulation.

So far, there have been several studies conducted to determine perception, knowledge, attitude and consumer acceptances' to the transgenic crops/foods, yet specifically for *Phytophthora* resistant potato varieties. So, the study is expected contribute to increase knowledge related to consumer acceptances' to transgenic crops.

## **Materials and Methods**

The survey was conducted on September to November in 2009. Household respondents were chosen as stratification of 101 persons in Bandung municipal, Indonesia. The stratification was based on income strata. Lower level with income was from IDR 1,000,000 to 2,000,000; middle level was from IDR 2,000,001 to 3,000,000 and high level was more that IDR 3,000,000.

The variables were characteristic of respondents, perception, attitude and respondent acceptances' to the potatoes transgenic. Data for perception and attitude were counted by qualitative statements on the ordinal scale (1 to 5) using Likert scale. Whereas, acceptance's data variable were measured by nominal scale (yes or no). Furthermore, the data were analyzed with Descriptive statistic method, Chi-square test and Logit binomial.

## **Results and Discussion**

### **Demographic and Socioeconomic of the Respondents**

The sums of respondents were 101, dominated by ages between 31 and 60 years, 78 respondents (78%), with average level of education were senior high school (34%). Most of the respondents were house wife (67%). Level of income per month were 1-2 millions rupiah (68%). The potatoes household average consumption ranged from 1 to 2 times per week (64%) with number of consumption was 1,05 kg.

### **Consumer Perceptions' to the Potatoes**

Descriptive statistic showed that more than 93% respondents stated that the potatoes was nutritious vegetable, made healthy, delicious and affordable by consumers, available in the market

and easy to be processed for any types of cuisines. As many as 88,1% respondents also said that the potatoes could be used as staple food (Table 1).

Table 1. Likert scale from household perception to the potatoes

Statements	Percentage (%)				
	1	2	3	4	5
The potatoes is nutritional food	6,9	91,1	2,0	0,0	0,0
The potatoes is a healthy food	11,9	87,1	0,0	1,0	0,0
The potatoes is delicious food	6,9	89,1	3,0	1,0	0,0
The potatoes price is affordable	6,9	88,1	3,0	2,0	0,0
The potatoes can be used as staple food	9,9	78,2	1,0	10,9	0,0
The potatoes is available in the market	31,7	68,3	0,0	0,0	0,0
The potatoes is easy to be processed	11,9	86,1	1,0	1,0	0,0

(1=strongly agree; 5=strongly not agree, N = 101)

### The Consumers' Potatoes Criteria

Taste is the most important criteria for the consumers. The results were consistent with previous study concluded that the consumers noticed more to potatoes tastes (Ameriana *et al.*, 1998). The color, taste and nutrition were also more important criteria's for the potatoes compared to the price, aroma and the safety to be consumed with value of 72,3; 24 and 50, 5%, respectively (Table 2).

Table 2. Likert scale from the consumer important criteria's to the potatoes

Statements	Percentage (%)				
	1	2	3	4	5
Taste	4,0	89,1	2,0	5,0	0,0
Nutritional	9,9	83,2	5,0	2,0	0,0
Appearance	13,9	83,2	1,0	2,0	0,0
Price	5,0	67,3	4,0	23,8	0,0
Color	12,9	83,2	1,0	3,0	0,0
Aroma	2,0	21,8	4,0	72,3	0,0
Safety to be consumed	22,8	26,7	4,0	46,5	0,0

(1=strongly agree; 5=strongly not agree, N = 101)

### Consumers' Perception and Attitude toward Transgenic Potatoes

Table 3 described that 70,3% of respondents always seeked the information of potatoes consumption. The information included the origin of the potatoes (respondents more likely the potatoes from Dieng-West Java), safety while be consumed, taste, size and the color.

Table 3. Likert scale on consumers' perception and attitude toward the potatoes

Statements	Percentage (%)				
	1	2	3	4	5
Always seek information of potatoes consumption.	3,0	67,3	2,0	27,7	0,0
Knowing transgenic foods on the market	2,0	38,6	12,9	46,5	0,0
Knowing transgenic potatoes (raw/processed) on the market.	0,0	0,0	7,9	91,1	1,0
Transgenic potatoes are safe to be consumed	2,0	33,7	20,8	42,6	1,0
Transgenic labeling should be attached	7,9	80,2	3,0	7,9	1,0
Circulation of food made from transgenic potatoes need to be informed on community	8,9	78,2	6,9	5,9	0,0
Pros and cons related to transgenic including to potatoes are occurred because of lack of information on consumer socialization.	0,0	84,2	10,9	5,0	0,0
Transgenic potatoes need to be introduced on the consumers	6,9	90,1	1,0	2,0	0,0

(1=strongly agree; 5=strongly not agree, N = 101)

More or less 40,6% of respondents ever heard the circulating transgenic food on the market. Specifically for the potatoes, most of the consumers (99%) were not informed. Therefore,

definition of potatoes transgenic should have been explained to the respondents at the beginning. After that, questions related to transgenic were asked. After the explanation, 40 respondents (40%) said that they would be looking for more information associated with the transgenic potatoes, while 60% of respondents were not decided yet to seek transgenic potatoes information because they were unaware with the product, beside that, they have already familiar with the potatoes sole on the market. All consumers were not aware toward transgenic potatoes circulation in the market whether they were in raw or processed product.

The survey also indicated that fewer consumers (36%) stated that the transgenic potatoes were safe and edible. Transgenic potatoes were derived by placing a gene from naturally blight resistant wild potato, so the origin was still from the potatoes, less pesticide and guaranteed from the government (Curtis *et al*, 2004) become the reasons of these arguments. Reducing pesticide becomes essential factor for consumer acceptances' to transgenic food (Wen and Rickertsen., 2002; Hoban, 1999). The positive response from consumers are might because the respondent did not have enough information about transgenic products (Onyango *et al*, 2004; Arianti., 2009). Study conducted by Jill *et al* (2001) indicated that they had less knowledge about biotechnology, they though more positive about the use of biotechnology in food production. The rest respondents had no opinion regarding to the transgenic potatoes since they had no knowledge what transgenic was.

Respondent opinions to the importance of transgenic labeling placed 88%. Consumers also argued that transgenic potatoes information should be disseminated to the communities. Furthermore, regarding the potatoes transgenic pros and cons, most of respondents' response the issues emerged because the community awareness toward the issues were still low due to the lack of information. Therefore, almost all consumers agreed that information about the transgenic potatoes should be shared to the communities.

### Consumer Acceptances' toward the Potatoes Transgenic

The consumer acceptances' to transgenic potatoes based on the consumer beliefs that the transgenic potatoes were safe to be eaten, consumer willingness to consume transgenic potatoes and the influence of debating transgenic potatoes to consumer decision resulted that 55.4% of consumers were willing to accept transgenic potatoes as long as no negative side effect. Moreover, the debate about transgenic crops does not affect consumer decisions to eat the product. About 44.6% of respondents were avoid to accept transgenic potatoes because they had no information, never heard and seen the potatoes, so that they were still reluctant to consume it.

Chi-square to test the connection between two variables among age, education, occupation, income, consumption frequency, perception, an important potato criteria's according to consumer and attitude showed that only consumption frequency and consumers' potato criteria significant was related to consumer acceptances' to transgenic potatoes with value 0,032 and 0,021 (table 4).

Table 4. Chi-Square test (significant in 5%, N=101)

No	Statements	Chi-square value
1	Age	0.781
2	Education	0.148
3	Occupation	0.687
4	Income	0.549
5	Consumption frequency	0.032*
6	Perception	0.226
7	Criteria's	0.021*
8	Attitude	0.303

Significant in 5%.

Meanwhile, logit binomial test indicated that the relationship between variables age, education, occupation, income, consumption frequency, perception, an important potato criteria's according to consumer and attitude overall to consumer acceptance's to transgenic potatoes resulted that age, occupation, income, consumption frequency and perception did not affect consumer acceptance's to transgenic potatoes. The variables affected consumer acceptance's were education and an important potato criteria's with value of 0,028 and 0,013, significant in 5%, respectively (Table 5).

Table 5. Logit binomial test

No	Statements	Logit value
1	Age	0.515
2	Occupation	0.367
3	Income	0.679
4	Consumption frequency	0.102
5	Perception	0.216
6	Attitude	0.315
7	Education	0.028*
8	Criteria's	0.013*

Significant in 5%.

## Conclusions

About 55,4% of consumers were willing to eat transgenic potatoes as long as no negative side effect, while 46% of them were not willing to consume it because they did not have any information about the products. The most factors influencing household acceptance to transgenic potato were consumption frequency and consumers' potato criteria. Moreover, logit binomial test showed that education and consumers' potato criteria were the most important factors for the household to accept the transgenic late blight resistant potatoes.

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# Relations Between the Amyloplast Sedimentation in Tubers and the Morphogenesis of Tubers in Yams

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## Abstract

Tubers which have different forms in Japanese yam (Jinenjo) and Chinese yams were used in this study. In developing tubers of all materials, amyloplasts were locally formed at the part beneath the stele in tuber apices. However, the numbers of total amyloplasts in each cell and settling amyloplasts in each cell at the parts of elongating tubers of Nagaimo and Jinenjo were greater than their numbers in the parts of thickening tubers of Genkotsujirou and Iseimo. When tubers of all materials matured, few amyloplasts were observed at the part. In this study, we discussed about the relations between the amyloplast sedimentation in tubers and the morphogenesis of tubers in yams.

*Keywords: amyloplast, gravitropism, morphogenesis, starch granule, yam*

## Introduction

The tuber of *Dioscorea* is generally regarded as a tuber but it has some characteristics different from conventional tubers. Therefore the tubers of *Dioscorea* are also regarded as rhizophores. The tubers have various shapes. Even in a cultivar or a line, the form of tubers may be variable. The inconstant nature causes the quality of tubers and the work efficiency to decrease. Previously we reported that many amyloplasts were locally formed and settled down by gravity at the apices of elongating tubers in Chinese yam (Kawasaki et al. 2008). In this study, relations between the amyloplast sedimentation in tubers and the tuber morphogenesis were investigated by using some Chinese yam (*Dioscorea opposita* Thunb.) and Japanese yam (*Dioscorea japonica* Thunb.).

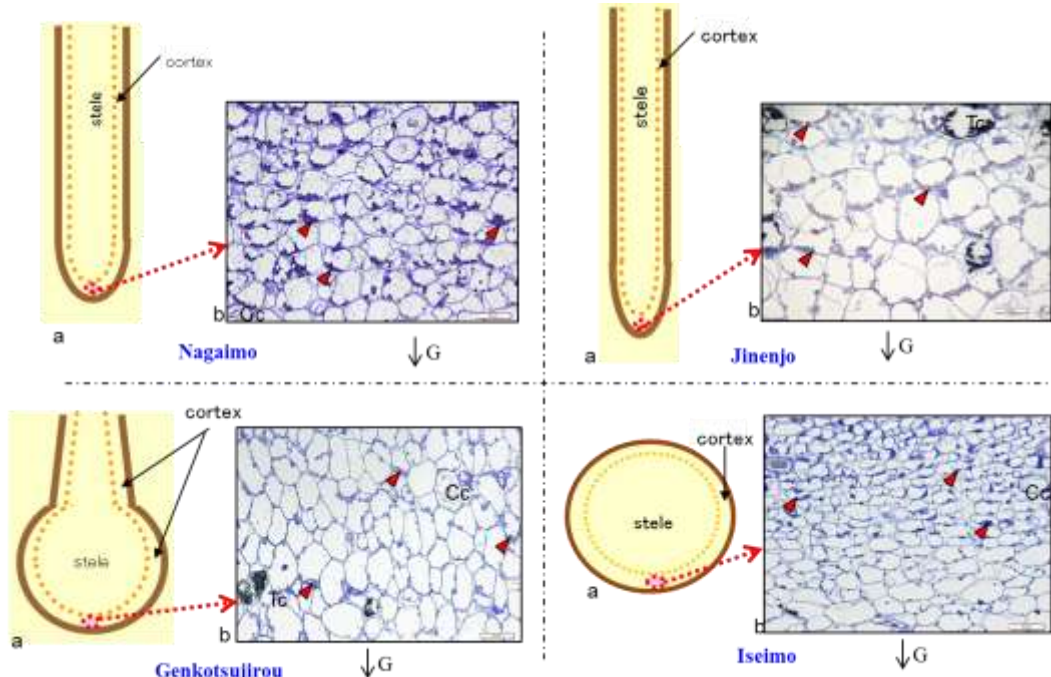
## Materials and Methods

Japanese yam (Jinenjo) and Chinese yam, cv. Nagaimo which elongate until their harvest times to form long tubers, Chinese yam, cv. Iseimo which spherically thickens until harvest time, Chinese yam, cv. Genkotsujirou which elongates in the initial stage and then spherically thickens, were used. Developing and mature tubers were sampled and observed with a light microscope. Morphological characterization related with amyloplasts in tuber apices was mainly investigated in this experiment.

## Results and Discussion

In developing tubers of all materials, amyloplasts were locally formed at the part beneath the stele in tuber apexes. However, at the part beneath the stele in tuber apexes, the numbers of amyloplasts in each cell and amyloplasts which settled down in each cell were not the same among materials. The numbers of amyloplasts and settling amyloplasts at the parts in elongating tubers of Nagaimo and Jinenjo were greater than their numbers at the parts in thickening tubers of Genkotsujirou and Iseimo (Fig.1). In Genkotsujirou, the number of amyloplasts which settled down at the part of tubers in thickening stage more decreased than it in elongating stage. In tubers of Iseimo, both the amyloplasts in each cell and the amyloplasts which settled down in each cell at the part were lower level throughout growing period. When tubers of all materials matured, few amyloplasts were observed at the part. While amyloplasts had been accumulated in parenchyma of stele in tubers with growing, their directional bias was not observed in each cell in all materials. Crystal cells and tannin cells dispersed in the part beneath the stele in tuber apices as in cortex surrounding the stele in all materials. The crystals and the tannin bodies were not also ubiquitous in each cell at the part in each material (Fig.1).

It was shown that the amyloplast sedimentation in tuber apices was common structural characteristic in some *Dioscorea* materials. In root caps of plants, amyloplasts have been reported to act as gravitusceptors (Blancaflor *et al.*, 1998; Perbal, 1999) and it is known that they are related to morphogenesis of the roots. The results from this study indicated that the amyloplast sedimentation would be concerned in gravity perception and the characteristic of the sedimentation possibly was concerned in the morphogenesis of tuber in each material. We are also carrying out further research with a lot more cultivars and lines in *Dioscorea* by using electron microscopes.



(a) Diagram of longitudinal section of tubers. (b) Longitudinal sections of the part beneath the stele in tips of developing tubers. The sections were stained with toluidine blue O. Arrowheads indicate amyloplasts. Cc, crystal cell; G, the direction of gravity; Tc, tannin cell. Genkotsujirou was investigated at thickening stage.

Figure 1. Amyloplast distribution in tips of developing tubers.

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