



## **Effect Induction Bio Hormone on Production and Content of Nutritional Substances on Tomato Fruit Variety Cherry Small Fry and Cherry Japan**



**Ni Putu Agustini <sup>a</sup>**  
**I Komang Agusjaya Mataram <sup>b</sup>**

---

### **Article history:**

**Received:** 9 November 2016

**Accepted:** 30 March 2017

**Published:** 31 May 2017

---

### **Abstract**

Food quality could be determined based on the criteria of food security, nutrition content, and trade standard on foodstuffs to food and beverages (Anonymous, 1996). At the stage of production or tomato cultivation system, the treatment accorded aims to increase the quantity and quality of tomatoes such as increased shelf life, organoleptic quality, and nutritional content. The content of the most prominent nutrient in tomatoes are vitamin C and carotene as forming pro-vitamin A. The content of vitamin C and carotene in tomatoes was useful to help the healing process sprue disease and night blindness. This type of research is experimentally using factorial completely randomized design. Factor I: Varieties of tomatoes which consists of two varieties, namely Cherry Small Fry (CSF) and Cherry Japan (CJ) and the second factor is the addition bio hormone i.e. non-induction bio hormone (B0) and induction bio hormone (B1). Each treatment was repeated 3 times so that overall there are 12 experimental units. Duncan test showed the CJ tomato induced growth hormone has the highest production with the average amount of 2449.10 grams. CJ tomato non-induced growth hormone has the lowest moisture content with the amount of 89.84%. CJ tomato induced growth hormone has the highest vitamin C levels with the average number of 133.07 mg / 100 g. CSF tomato non-induced growth hormone has the highest carotene content with average number 15297.09 ug / 100 g. Induction of growth hormone on tomato plants can increase the amount of production, with a high vitamin C content and low moisture content. Suggested tomato varieties to be developed is the Japanese Cherry tomato varieties (CJ) compared Cherry tomatoes Small Fry (CSF).

2454-2261 ©Copyright 2017. The Author.  
This is an open-access article under the CC BY-SA license  
(<https://creativecommons.org/licenses/by-sa/4.0/>)  
All rights reserved.

---

### **Author correspondence:**

Ni Putu Agustini,

Nutrition Department of Health Polytechnic Denpasar, Bali, Indonesia

Email address: [niputuagustini1965@gmail.com](mailto:niputuagustini1965@gmail.com)

---

<sup>a</sup> Department of Nutrition Health Polytechnic Denpasar, Bali, Indonesia

<sup>b</sup> Department of Nutrition Health Polytechnic Denpasar, Bali, Indonesia

## 1. Introduction

Quality can be determined based on the criteria of food security, nutrition content, and trade standard on foodstuffs to food and beverages (Anonymous, 1996). Tomatoes are generally consumed in the form of fresh or processed. At the stage of production or tomato cultivation system, the treatment accorded aims to increase the quantity and quality of tomatoes such as increased shelf life, organoleptic quality, and nutritional content. The content of the most prominent nutrient in tomatoes are vitamin C and carotene as forming pro-vitamin A. The vitamin C and carotene in tomatoes is useful to help the healing process sprue disease and night blindness. Tomatoes also contain lycopene and fiber that serves to reduce the levels of LDL (Low-Density Lipoprotein) in the blood (Wiryanta and Wahyu, 2002). Tomato cultivation system to increase productivity also experienced a shift from the conventional system into a system of cultivation using plastic mulch or with a hydroponic system. Culture systems to increase production also followed by the use of biotechnological processes such as the use of growth hormone to stimulate plant growth and development, so that the plant cells are stimulated to cell division and differentiation.

Growth hormone often used to stimulate plant growth and development include auxin, gibberellins, and cytokinins. This hormone formulations can be added with various vitamins such as thiamin, pyridoxine, nicotinic acid and mineral types. Plant growth regulator auxin, gibberellins, and cytokines work synergistically in the plant that is characterized by the development of plants. Plant growth regulators are given on potato simultaneously indicate a rapid shoot growth in the development of the potato plant stolen. At certain concentrations of Plant growth regulator can support or inhibit cell division, which plays a role in the growth and development of plants so that the plants remain healthy (Danoesastro, 1976; Salisbury and Ross, 1995).

In Hawaii ever made use of gibberellins to increase sugar cane and sugar production, increase production and crispness on celery plants, and the cause of wine grape plants resistant to fungal infections (Salisbury and Ross, 1995; Anonymous, 2004). Research that examines the influence of hormones and minerals to fruit quality characteristics, such as in tomatoes has not been done. This study aimed to determine the effect of growth hormone on the production, moisture content, vitamin C and carotene content of tomato fruit varieties Cherry Small Fry and Cherry Japan.

## 2. Materials and Methods

This type of research is experimentally using factorial completely randomized design. Factor I: Varieties of tomatoes which consists of two varieties, namely Cherry Small Fry (CSF) and Cherry Japan (CJ) and the second factor is the addition bio hormone ie non-induction bio hormone (B0)and bio hormone induction (B1). Each treatment was repeated 3 times so that overall there are 12 experimental units (Heryanto, 1996). Bio hormone is given to the treatment group one week after planting on polybags and hereafter is given once every week at a dose of 2 ml per plant for 5 months.



Figure 1. Cherry Small Fry



Figure 2. Cherry Japan

### 3. Results and Discussions

Based on the Shapiro-Wilk test all of the data showed normal distribution because of the significant value  $> 0.05$  ( $p > 0.05$ ). (Table 1). The statistical test followed by a parametric test that is One Way Anova.

Table 1  
Normality Test Data with the Shapiro-Wilk test

Variables	Treatment	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Production	Induction CSF	.204	3	.	.993	3	.845
	Non Induction CSF	.176	3	.	1.000	3	.988
	Induction CJ	.198	3	.	.995	3	.871
	Non Induction CJ	.360	3	.	.809	3	.135
Moisture Content	Induction CSF	.369	3	.	.788	3	.087
	Non Induction CSF	.290	3	.	.926	3	.474
	Induction CJ	.349	3	.	.832	3	.194
	Non Induction CJ	.177	3	.	1.000	3	.961
Vitamin C	Induction CSF	.177	3	.	1.000	3	.967
	Non Induction CSF	.354	3	.	.821	3	.166
	Induction CJ	.335	3	.	.859	3	.264
	Non Induction CJ	.370	3	.	.786	3	.082
Carotene	Induction CSF	.371	3	.	.784	3	.077
	Non Induction CSF	.363	3	.	.801	3	.117
	Induction CJ	.299	3	.	.914	3	.430
	Non Induction CJ	.353	3	.	.824	3	.172

Note: CSF: Cherry Small Fry; CJ: Cherry Jepang

Based Test Levene homogeneity test all variables measured showed significant values  $> 0.05$  ( $p > 0.05$ ) so that all data can be concluded homogeneous (Table 2).

Table 2  
Homogeneity Test Result Data with Levene Test

Variables	Levene Statistic	df1	df2	Sig.
Production	1.475	3	8	.293
Moisture content	1.909	3	8	.207
Vitamin C	1.527	3	8	.280
Carotene	1.909	3	8	.207

If the value of variables between groups  $p < 0.05$  then we can conclude there is a significant difference between treatments. Table 3 shows the measured variable has a value of  $p < 0.05$  so it can be concluded production, moisture content, vitamin C and carotene were significantly different between treatments.

Table 3  
Anova Test Results

Variables	Analysis	Sum of Squares	df	Mean Square	F	Sig.
Production	Between Groups	365637.450	3	121879.150	4.994	.031
Moisture content	Between Groups	17.716	3	5.905	22.735	.000
Vitamin C	Between Groups	10967.367	3	3655.789	626.936	.000
Carotene	Between Groups	6.186E7	3	2.062E7	15.982	.001

a. Production

Table 4 shows the Small Fry Cherry tomato varieties (CSF) induction treatment with growth hormone significantly different with non-induced CSF tomato, but no different from tomato varieties Japanese Cherry (CJ) induced and non-induced. Tomato varieties CJ induced by growth hormone significantly different with tomato CSF non-induced and non-induced CJ, but not different with tomato CSF induction.

Table 4  
Post Hoc Test Tomato Production Test by Treatment

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
LSD	Induction CSF	361.00333*	127.55467	.022	66.8617	655.1449
	Induction CJ	-38.83000	127.55467	.769	-332.9716	255.3116
	Non Induction CJ	288.67000	127.55467	.053	-5.4716	582.8116
	Non Induction CSF	-361.00333*	127.55467	.022	-655.1449	-66.8617
	Induction CJ	-399.83333*	127.55467	.014	-693.9749	-105.6917
	Non Induction CJ	-72.33333	127.55467	.586	-366.4749	221.8083
Induction CJ	Induction CSF	38.83000	127.55467	.769	-255.3116	332.9716
	Non Induction CSF	399.83333*	127.55467	.014	105.6917	693.9749
	Non Induction CJ	327.50000*	127.55467	.033	33.3584	621.6416
Non Induction CJ	Induction CSF	-288.67000	127.55467	.053	-582.8116	5.4716
	Non Induction CSF	72.33333	127.55467	.586	-221.8083	366.4749
	Induction CJ	-327.50000*	127.55467	.033	-621.6416	-33.3584

CSF: Cherry Small Fry; CJ: Cherry Jepang

Duncan's test showed that induced growth hormone CJ tomatoes had the highest production with an average number of 2449.10 grams (Table 5).

Table 5  
Duncan Test Result of Tomato Production by Treatment

	Treatment	N	Subset for alpha = 0.05		
			1	2	3
Duncan <sup>a</sup>	Non Induction CSF	3	2049.2667		
	Non Induction CJ	3	2121.6000	2121.6000	
	Induction CSF	3		2410.2700	2410.2700
	Induction CJ	3			2449.1000
	Sig.		.586	.053	.769

b. Moisture content

Table 6 shows the significantly different growth hormone induced Cherry Small Fry (CSF) tomatoes with Japanese Cherry (CJ) induction and non-induced CJ, but no different from non-induced CSF tomatoes. Tomato CJ varieties induced by growth hormone differed significantly with induced CSF tomatoes and non-induced CSF, but no different from non-induced CJ tomatoes.

Table 6  
Post Hoc Test Result of Tomato Moisture Content by Treatment

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Induction CSF	Non Induction CSF	.07667	.41613	.858	-.8829	1.0363
		Induction CJ	2.07333*	.41613	.001	1.1137	3.0329
		Non Induction CJ	2.76333*	.41613	.000	1.8037	3.7229
	Non Induction CSF	Induction CSF	-.07667	.41613	.858	-1.0363	.8829
		Induction CJ	1.99667*	.41613	.001	1.0371	2.9563
		Non Induction CJ	2.68667*	.41613	.000	1.7271	3.6463
Induction CJ	Induction CSF	Induction CJ	-2.07333*	.41613	.001	-3.0329	-1.1137
		Non Induction CSF	-1.99667*	.41613	.001	-2.9563	-1.0371
		Non Induction CJ	.69000	.41613	.136	-.2696	1.6496
	Non Induction CJ	Induction CSF	-2.76333*	.41613	.000	-3.7229	-1.8037
		Non Induction SF	-2.68667*	.41613	.000	-3.6463	-1.7271
		Induction CJ	-.69000	.41613	.136	-1.6496	.2696

The Duncan test showed that non-induced growth hormone CJ tomatoes had the lowest moisture content of 89.84% (Table 7).

Table 7  
Duncan Test Result of Tomato Moisture Content by Treatment

	Treatment	N	Subset for alpha = 0.05	
			1	2
Duncan <sup>a</sup>	Non-Induction CJ	3	89.8433	
	Induction CJ	3	90.5333	
	Non-Induction CSF	3		92.5300
	Induction CSF	3		92.6067
	Sig.		.136	.858

c. Vitamin C

Table 8 shows the significantly different growth hormone-induced Cherry Small Fry (CSF) tomatoes with non-induced CSF tomatoes, non-induced and induced Cherry Japanese (CJ) tomatoes. Tomato CJ varieties induced by growth hormone differ significantly with induced CSF tomatoes, non-induced CSF tomatoes, and non-induced CJ tomatoes.

Table 8  
Post Hoc Test Result of Vitamin C Tomato by Treatment

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval		
					Lower Bound	Upper Bound	
LSD	Induction CSF	Non Induction CSF	5.10667*	1.97167	.032	.5600	9.6533
		Induction CJ	-70.48667*	1.97167	.000	-75.0333	-65.9400
		Non Induction CJ	-32.51333*	1.97167	.000	-37.0600	-27.9667
	Non Induction CSF	Induction CSF	-5.10667*	1.97167	.032	-9.6533	-.5600
		Induction CJ	-75.59333*	1.97167	.000	-80.1400	-71.0467
		Non Induction CJ	-37.62000*	1.97167	.000	-42.1667	-33.0733
	Induction CJ	Induction CSF	70.48667*	1.97167	.000	65.9400	75.0333
		Non Induction CSF	75.59333*	1.97167	.000	71.0467	80.1400
		Non Induction CJ	37.97333*	1.97167	.000	33.4267	42.5200
Non Induction CJ	Induction CSF	32.51333*	1.97167	.000	27.9667	37.0600	
	Non Induction CSF	37.62000*	1.97167	.000	33.0733	42.1667	
	Induction CJ	-37.97333*	1.97167	.000	-42.5200	-33.4267	

The Duncan test showed that induced growth hormone CJ tomatoes had the highest levels of vitamin C with an average of 133.07 mg / 100 g. (Table 9).

Table 9  
Duncan Test Result of Vitamin C by Treatment

	Treatment	N	Subset for alpha = 0.05		
			1	2	3
Duncan <sup>a</sup>	Non-Induction CSF	3	57.4767		
	Induction CSF	3		62.5833	
	Non-Induction CJ	3			91.7633

Induction CJ	3		133.0700
Sig.		.089	1.000

## d. Carotene

Table 10 shows the significantly different growth hormone induced Cherry Small Fry (CSF) tomatoes with both induced and non-induced Cherry Japanese (CJ) tomatoes, but no different from non-induced CSF tomatoes. Tomato CJ varieties induced by growth hormone differ significantly with induced CSF induction and non-induced CSF tomatoes, but no different with non-induced CJ and tomatoes.

Table 10  
Post Hoc Test Result of Carotene by Treatment

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval		
					Lower Bound	Upper Bound	
LSD	Induction CSF	Non Induction CSF	-263.94000	927.40737	.783	-2402.5452	1874.6652
		Induction CJ	3275.75000*	927.40737	.008	1137.1448	5414.3552
		Non Induction CJ	5142.01000*	927.40737	.001	3003.4048	7280.6152
	Non Induction CSF	Induction CSF	263.94000	927.40737	.783	-1874.6652	2402.5452
		Induction CJ	3539.69000*	927.40737	.005	1401.0848	5678.2952
		Non Induction CJ	5405.95000*	927.40737	.000	3267.3448	7544.5552
	Induction CJ	Induction CSF	-3275.75000*	927.40737	.008	-5414.3552	-1137.1448
		Non Induction CSF	-3539.69000*	927.40737	.005	-5678.2952	-1401.0848
		Non Induction CJ	1866.26000	927.40737	.079	-272.3452	4004.8652
Non Induction CJ	Induction CSF	-5142.01000*	927.40737	.001	-7280.6152	-3003.4048	
		Non Induction CSF	-5405.95000*	927.40737	.000	-7544.5552	-3267.3448
		Induction CJ	-1866.26000	927.40737	.079	-4004.8652	272.3452

The Duncan test showed that non-induced growth hormone CSF tomatoes had the highest carotene content with an average number of 15297.09 ug / 100 g (Table 11).

Table 11  
Duncan Test Result of Carotene by Treatment

	Treatment	N	Subset for alpha = 0.05	
			1	2
Duncan <sup>a</sup>	Non-Induction CJ	3	9891.1467	
	Induction CJ	3	11757.4067	
	Induction CSF	3		15033.1567
	Non-Induction CSF	3		15297.0967
	Sig.		.079	.783

## Discussion

Duncan's test showed that growth-induced CJ-induced CJ tomatoes had the highest production with an average number of 2449.10 grams, followed by an induced tomato CSF with an average of 2410.27 grams (Table 5). Non-induced growth hormone CJ tomato has the moisture content with an average amount of 89.84%, followed by an induced CJ tomato with an average number of 90.53% (Table 7). The induced growth hormone CJ Tomato has the

highest vitamin C content with an average amount of 133.07 mg / 100 g, followed by non-induced CJ tomatoes with an average of 91.76% (Table 9). The non-induced growth hormone CSF tomato had the highest carotene content with an average amount of 15297.09 ug / 100 g, followed by CSF induced tomatoes with an average number of 15033.15 ug / 100 g (Table 11).

Based on the results obtained by treatment of growth hormone induction on CJ tomato is more suitable to obtain the product with high vitamin C content and lower water content. Carotene levels in CSF tomatoes indicate hormone induction has not been affected. The growth hormone formula used in this study contains auxin, gibberellin, and cytokinin also supplemented with vitamins such as thiamin, pyridoxine, nicotinic acid and several types of minerals. Hormones auxin effect on the process of parthenocarpy the formation of fruit without seed, stem growth and fruit growth. Gibberellin is one important factor that plays a role in spurring interest growth. Cytokines are growth regulators found in plants. Cytokines have a role in the process of cell division.

Several studies have revealed the role of hiohormons such as gibberellin, auxin, and cytokines or their combination of plant growth with a focus on flowering, growth, fertilization and storage. The study of the role of gibberellins against flowering by the treatment of dosing of 500 mg/l gibberellin in *Spathiphyllum muna loa* flower obtained flowering results at the tenth week after treatment, while the flowering control occurred only at twenty weeks (Abidin, 1985). Henny *et al.*, (2000) study of the role of gibberellin in *Spathiphyllum* varieties showed that higher concentrations of gibberellin produced higher amounts of interest (Henny *et al.*, 2000). Crane Research (1969) using 2,4,5-Trichlorofenoxy acetate as exogenous auxin applied to blackberries, grapes, strawberries, and oranges showed that fruit growth was 60 days faster than the normal phase average of 120 days (Crane, 1969). The Research of Parman (2015) on the given of gibberellin in IR-64 rice plants (*Oryza Sativa* var IR = 64) with concentrations varying from 5 mg / l to 20 mg / l. The result obtained is the concentration of gibberellin 10 mg / l is the optimum concentration of high growth and number of tillers of rice (Parman, 2015).

The research of Wulandari *et al.* stated giving gibberellin with a concentration of 200 ppm effect on fruit weight and a number of seeds on cucumber fruit mercy.<sup>11</sup> Gibberellin synthesis that is usually available in the market is GA3, GA7, and GA13 (Wattimena *et al.*, 1991). The results showed that GA3 in peanut plants caused stunted to be high. Gibberellin is useful in the process of parthenocarpy (fruit without seeds) and the number of fruit bunches (Parnata, 2004).

The results of research on the immersion of Delaware type of grapes fruit at the time before flowering in an aqueous solution of GA3 can yield 88-96% seedless fruit. Gibberellin is useful in the engineering process to produce unbranded fruit and increase the number of bunches in fruit and increase fruit yield. Giving of gibberellins can also cause the harvested fruits to not quickly rot, making them more durable (Gardner *et al.*, 1991).

In the germination phase, the role of gibberellins is very advantageous. Gibberellin helps the enzymatic process to convert starch into sugars which are subsequently translocated into the embryo. Sugar will be used as a source of energy for growth, so growth is fast. Gibberellins can increase cambium activity and xylem development so growth activity can smoothly and quickly (Salisbury and Ross, 1995).

The research of Asra and Ubaidillah (2012) showed that gibberellin concentration in *calopogonium caeruleum* plant has no significant effect on crude protein, acid detergent and neutral detergent fiber in *calopogonium caeruleum* (Asra and Ubaidillah, 2012), however Asra (2014) stated that the interaction of GA3 concentration (500 ppm) and soaking time (24 hours) showed a significant effect on the percentage of germination and vigorous *calopogonium caeruleum* (Asra, 2014).

The use of gibberellin in grapefruit causes grapes resistant to fungal infections. Spraying gibberellin on citrus fruit and leaves can prevent the interference of the fruit skin and keep skin tight during storage. Therefore gibberellin can cause plants to be more resistant to disease (Salisbury and Ross, 1995; Abidin, 1985; Parnata, 2004).

Cytokines are often also called kinetin and are a generic name for growth substances that specifically stimulate cell division (Gardner *et al.*, 1991). The growth regulator auxin, gibberellins, and cytokinins work synergistically in plants that are characterized by plant growth. The growth regulator substances given to potato plants simultaneously show a rapid growth of buds in the development of potato plant stolon. At certain concentrations, the growth regulator can support or inhibit cell division, which a role in the growth and development of plants so that plants remain healthy (Danoesastro, 1976; Salisbury and Ross, 1995).

Based on the results of research supporting this research, among others, (Crane, 1969; Parman, 2015; Pranata, 2004; Gardner *et al.*, 1991) showed that the effect of gibberellin affects growth, which in turn has an impact on increased production. Asra and Ubaidillah (2012) obtained gibberellin results have not been able to increase the nutrient content, especially crude protein content, acid detergent fiber and neutral detergent fiber in *calopogonium*

caeruleum plant. These results do not support considering the results of research states gibberellin can increase the content of nutrients, especially vitamin C and carotene.

#### 4. Conclusion

Induction of growth hormone in tomato plants can increase the amount of production, with high levels of vitamin C and low water content. The recommended tomato varieties to be developed are Japanese Cherry varieties (CJ) compared to Cherry Small Fry tomatoes (CSF).

##### *Conflict of interest statement and funding sources*

The author(s) declared that (s)he/they have no competing interest. The study was financed by the authors.

##### *Statement of authorship*

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

##### *Acknowledgments*

Further thanks to the director, chairman of the nutrition department for the support and to Professor I Gede Putu Wirawan, Professor I Ketut Suter, for guidance and suggestions were given, also to the Udayana University of Denpasar Laboratory.

**References**

Abidin, Z. (1985). *Wajo pada abad XV-XVI: suatu penggalian sejarah terpendam Sulawesi Selatan dari lontara'*. Alumni.

Asra, R., & Ubaidillah, U. (2012). Pengaruh Konsentrasi Giberelin (GA3) Terhadap Nilai Nutrisi Calopogonium caeruleum. *Jurnal Ilmiah Ilmu-Ilmu Peternakan*, 15(2), 81-85.

Asra, R., Shrivastava, M., Murali, K. V., Pandey, R. K., Gossner, H., & Rao, V. R. (2011). A tunnel FET for  $\$ V_{DD}$  scaling below 0.6 V with a CMOS-comparable performance. *IEEE Transactions on Electron Devices*, 58(7), 1855-1863.

Crane, J. C. (1969). The role of hormones in fruit set and development. *HortScience*, 4(2), 1969-1970.

Danoesastro, H. (1976). Pohon Buah-buahan. *Yayasan Pembina Fakultas Pertanian Gama*, Yogyakarta.

Gardner, F. P. R. B. (1991). Pierce & Mitchell.

Henny, R. J., Chen, J., & Mellich, T. A. (2000). Flowering response of three *Spathiphyllum* cultivars to treatment with three levels of gibberellic acid. In *Proceedings of the Florida State Horticultural Society* (Vol. 113, pp. 169-170). Florida State Horticultural Society.

Heryanto, E. (1996). Rancangan percobaan pada bidang pertanian. *Trubus Agrowidya. Ungaran*.

Indonesia, R. (1999). Undang-Undang No. 8 Tahun 1999 Tentang Perlindungan Konsumen. *Lembaran Negara RI Tahun*, 8.

Minuto, A., Spadaro, D., Garibaldi, A., & Gullino, M. L. (2006). Control of soilborne pathogens of tomato using a commercial formulation of *Streptomyces griseoviridis* and solarization. *Crop Protection*, 25(5), 468-475.

Parman, S. W. (2015). Time-lapse zirconography: imaging punctuated continental evolution. *Geochemical Perspectives Letters*, 1(1), 43-52.

Parnata, A. S. (2004). *Pupuk Organik Cair Aplikasi & Manfaatnya*. Agromedia.

Salisbury, F. B., & Ross, C. W. (1995). *Fisiologi Tumbuhan, Perkembangan Tumbuhan dan Fisiologi Lingkungan. Jilid Tiga*. Terj. DR Lukman & Sumaryono. ITB. Bandung.

Wattimena, G. A., Purwito, A., Mattjik, N. A., & Pranoto, F. L. (1991). Maximizing potato microtuber production through manipulations of growth retardants. *Indonesian Journal of Tropical Agriculture*, 2, 94-96.

Wiryanta, B. T. (2002). Wahyu, Bertanam Cabai pada Musim Hujan.

Wulandari, D. C. (2014). Pengaruh Pemberian Hormon Giberelin terhadap Pembentukan Buah secara Partenokarpi pada Tanaman Mentimun Varietas Mercy. *LenteraBio*, 3(1).

### Biography of Authors



#### Education background:

1. Academy of Nutrition Malang, Indonesia (1987)
2. Faculty of Community Health, University of Airlangga Surabaya, Indonesia (1995)
3. Biotechnology of Agriculture, University of Udayana Denpasar, Indonesia (2006)

Previous publication (Local Journal)

1. Micro E.coli contamination on Es Daluman for Sale in Denpasar City. *Journal of Skala Husada*, Vol 12 No.1, April 2015.
2. Nutritional and Physical Characteristics of Sweet Potato Flour and Taro Thermally Modified with Amylase Enzyme. *Journal of Skala Husada*, Vol 11 No.1, April 2014.
3. Identification of Rhodamine B on Snacking Puppies and Jajan Sirat at Pekutatan Village, Jembrana Regency. *Journal of Nutrition Science*, Vol V, No.1 in 2014.
4. Drink Energy Consumption Based on the Characteristics and Level of Employee Knowledge Hotel Sanur Beach Denpasar Bali. *Journal of Skala Skala Husada*, Vol 8, No.1, April 2011.
5. Genetically Modified Food Security Aspect Food. *Journal of Nutrition Science*, Vol 2 No. February 1, 2011.

#### Unpublished publication:

1. Application of HACCP (Hazard Analysis Critical Control Point) As a Quality Assurance Model of Food Safety at Sanglah General Hospital Denpasar Denpasar Province, 2015.
2. Security Analysis of Es Daluman in Denpasar, 2014.
3. Effectiveness of Counseling on the Behavior of Clean and Healthy Life on Improving the Knowledge of Primary School Children in Tulikup Village, Gianyar Regency, 2011.

#### Work:

Lecturer in the Department of Nutrition Health Polytechnic Denpasar (1989 until now)

Email: [niputuagustini1965@gmail.com](mailto:niputuagustini1965@gmail.com)



#### The author of education background

1. Academy of Nutrition Jakarta, Indonesia (1985)
2. Family Resources Community Nutrition, IPB Bogor, Indonesia (1989)
3. Master of Health Services Management, UGM Yogyakarta, Indonesia (1999)
4. Doctoral Program in Medical Sciences, Public Health Sciences, University of Udayana Denpasar, Bali, Indonesia (2014)

#### International Publications

1. Stunting Cause Factors in The Village of Traditional Bali. *International Research Journal of Engineering, IT & Scientific Research (IRJEIS)* Vol. 3 Issue 2, March 2017  
Available online at <http://ijcu.us/online/journal/index.php/irjeis>

#### Previous publication (Local Journal)

1. Aspects of Immunology Mother's Milk, *Jurnal Ilmu Gizi*, Vol. 2, No. 1, February 2011.
2. Integrated Health Pos (Posyandu) Revitalization Efforts With Knowledge Increases in the Village Kesiman Kertalangu Kader. East Denpasar, *Jurnal Skala Husada*, 2010, 7(1)
3. Knowledge level and the level of iodized salt consumption Characteristics Based Capital In the village of Seraya Barat Karangasem district Karangasem Bali Province. *Jurnal Skala Husada*, 2009, 6(2)
4. Perception and Application of Balanced Nutrition in Adolescents high schools in

Denpasar Bali Province, Proceedings of the National Congress Persagi and XIV in Surabaya Scientific Meeting November 12-14, 2009.

5. Application of Behavior Clean and Healthy Lifestyle (PHBs) In Household In Order To Achieve Healthy Community Self In the province of Bali. Proceedings of the Symposium HRH No. ISBN 978-602-9531-0-4, in the Context of the Ministry of Health Polytechnic VIII Anniversary of Denpasar, April 14, 2009.

6. Study Making of "Lala Chip" High Snacks Iodine. Proceedings of the National Congress of Indonesian Nutritionist Association (Persagi) and XII Scientific Meeting in Jakarta 8-10 July 2002.

Unpublished publication

1. Weighing Through the optimization activities Posyandu Cadre Training Kertalangu In the Village Kesiman, East Denpasar, Denpasar City, Bali Province (2008).
2. Effectiveness Booklet Knowledge To Improve Primary School Children As Iodized Salt Supply Innovators Families In District of Sidemen, Karangasem, Bali Province (2007).
3. Goiter Program Impact Evaluation In the district of Karangasem, Bali Province (2005).
4. Monitoring Maternal Chronic Energy Deficiency (KEK) Bali Province Year 2005 (2005).
5. Impact Evaluation Feeding (PMT) On Children Under Five Malnutrition and Factors Affecting (2004).
6. Improved knowledge base About the undernourishment School Children by Utilizing Flannel Graf Viewer Tool to Increase Availability As Iodized Salt at Household Level (2003).
7. Study Making Formula of Anti Goiter (Phase II Trial in the Field) (2000).
8. Distribution and Level Evaluation System Availability iodized salt Endemic goiter On In Area Regional Health Office Bangli regency of Bali Province (1999).
9. Study Making Formula Anti Goiter (1998).

Work:

Lecturer in the Department of Nutrition Health Polytechnic Denpasar (1985 until now)