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NITRATE CONTENT AS EXPORT CONSTRAIN OF INDONESIAN VEGETABLES TO EUROPE

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Abstract

Vegetable quality is determined by the physical properties, chemistry, color, and taste. Since increased public awareness of health, their demand on food quality has also increased. Chemical properties of vegetables include: level of nitrate, pesticide residue and heavy metal content. The purpose of this paper is to provide information to Indonesian vegetables stakeholder, the European markets impose strict conditions on levels of nitrate vegetables. The method used is the study of literature from a variety of credible sources. In the human's stomach is reduced nitrate to nitrite, then nitrite reacts with amines to form nitrosamine compound. Nitrosamine is known as a very potential carcinogenic compound, with risk of 90%. Statistically, 72.4% of daily nitrate intake originated from vegetables, equal to 35.7 mg/day. Besides forms nitrosamine, nitrite couse methemoglobinamie (baby blue syndrome). Nitrate is very serious threat to human health, so that the WHO limit the maximum daily nitrate intake do not exceed 220 mg (Scharpf and Wehrmann, 1991). To protect their citizen against nitrate hazard, European government are agreed to limit the maximum nitrate content in vegetables. Each species of vegetable and Country has different nitrate limit. Indonesian's vegetable contain high nitrate level and difficult to reduce because there is no technology have been developed to quantify N supply to achieve low nitrate content. Growers in developed countries (Europe, USA, Japan, and Canada) apply N-mineral Metode to maintain nitrogen supply and nitrate content. Wijaya (2012) have analyzed 5 species of vegetables (spinach, pachoy, cabage, lettuce and chinakol) resfectivly contain 6.427, 3.915, 1.847, 1.553, and 704 mg/kg FS). Acording to these nitrate content and nitrate limiting role of European Countries, very hard for Indonesia to export Indonesian vegetables to Europe.

Keywords: Indonesian vegetable, nitrate, export, Europen market

I. INTRODUCTION

Indonesia has agriculture land 22.5 million hectare with population of 230 million people. When supported by adequate technology, those facts as natural capital to produce qualified vegetables, but is really not easy to produce export qualified vegetables. Since, the buyer's requested quality difficult achieved by vegetables producer that not owned adequate technology and infrastructure yet, like Indonesia.

Quality of vegetable are determined by some criteria such as physically, chemically, color, and taste. But, since people awareness to healthy increase, people's requirement to healthy and qualified vegetable also arose. Some chemical contents are pesticide residue, heavy metal, and nitrate. Along with medicine science progress, known that nitrosamine as the most dangerous carcinogenic with 90% of risk. Nitrosamine formed in human stomach from reaction of nitrite and amine. Nitrite originated from nitrate that contained in vegetables. Statistically, 72.4% of daily nitrate's intake originated from vegetables, equal with 35.7 mg/day.

Epidemic study showed a possitive corelation between nitrate intake and cancer risk in Chille, China, Columbia, Denmark, and Italy (Preussmann, 1993). Besides form nitrosamine, nitrate couse methemoglobinamie (baby blue syndrome). Nitrate treaten human healthy seriouslly, therefore WHO recommend the maximum daily nitrate intake as high as 220 mg (Scharpf and Wehrmann, 1991).

II. EXPORT OF INDONESIAN VEGETABLES

Indonesia has been exported some species of vegetables to some countries, but in small amount and to Asia countries. Exported volume to produced volume was classified small (Table 1). From 13 species exported vegetables, potato was 9.6% from total produced amount, that was the highest. The rests were 0.08 to 2.6%. There are some reasons why the exported amount was small, because lack of quality, discontinuity of supply, and lack of production. National supply (2007) per capita was 40.5 kg and national per capita consumption was 34 kg.

Table 1. Production and Export Volume of Vegetables (2006)

Species	Product (Ton)	Export (Ton)	% Export
Potato	1,011,911	97,657	9.6
Tomato	629,744	1,024	0.2
Onion	794,929	15,700	1.9
Garlic	21,052	17	0.08
Cabage	1,267,745	32,665	2.6
Cauliflower	135,517	1,696	1.3
Cucumber	598,892	1,161	0.2
Eggplant	358,095	362	0.1
Carrot	391,370	439	0.1
Kidney bean	125,251	247	0.2
French bean	269,533	1,357	0.5
Spinach	149,435	348	0.2
Chili	736,019	8,004	1.1

Source : Pusdatin and BPS

III. EXPORT CONSTRAIN OF INDONESIAN VEGETABLES

There are some constrain of vegetables export to abroad such as 1) quality of vegetables requested by importing countries, and 2) supplied amount and time of supply.

The most difficult to be solved is quality of vegetables requested by importing countries. Besides outer quality such as physically appearance and color, inner quality such as nitrate minimum content of harvest material, sugar and vitamins C, pesticide residue, and heavy metal content are more difficult to realize without any acquired fertilization technology. Have we such technology that able to maintain nitrogen supply to achieve requested quality?

Growers in developed countries (Europe, USA, Japan, and Canada) apply N-mineral Metode to maintain nitrogen supply to crops, but Indonesia still fertilize their crops according to recommended dosage that lack of precision.

VI. NITRATE LIMITATION OF SOME EUROPEAN COUNTRIES

To protect their citizen against nitrate hazard, European government are agreed to limit the maximum nitrate content of vegetables. What is the maximum limit and for which vegetables, each country is differ (see Table 2). Indonesian vegetables growers don't know how importance the limitation of nitrate content of vegetables for human healthy.

Table 2. The Upper Limit of Nitrate Content in Vegetables

Vegetables	The Upper Limit of Nitrate (mg/kg FW)			
	Germany	Holland	Swiss	\ustria
Baby Food RM	250	-	-	250
Head Lettuce	3000	3000	3500	3000
Spinach	2000	3500	3500	2000
Red Beet	3000	3500	3000	3500

Batavia	-	3000	-	2500
Radish	3000	-	-	3500
Field Lettuce	2500	-	3500	3500
Cabbage	-	-	875	1500
Chicory	-	-	-	1500
Laic	-	-	-	1500
French Bean	-	-	-	1500
Carrot	-	-	-	1500
Celery	-	-	-	1500
China Lettuce	-	-	-	2500
Kohlrabi	-	-	-	3500
Fennel	-	-	2000	-
Parsley	-	-	-	3500

Source: Scharpf (1991)

Above mentioned countries are very strict in nitrate limitation, where Indonesian growers have to work harder if they want export their vegetables to.

As the baby-food raw materials, the requirements are much more stringent levels of nitrate, which is 200 mg / kg of FW for all kinds of vegetables except broccoli, eggplant and red chili respectively 450, 250 and 100 mg/kg of FW (see Table 3).

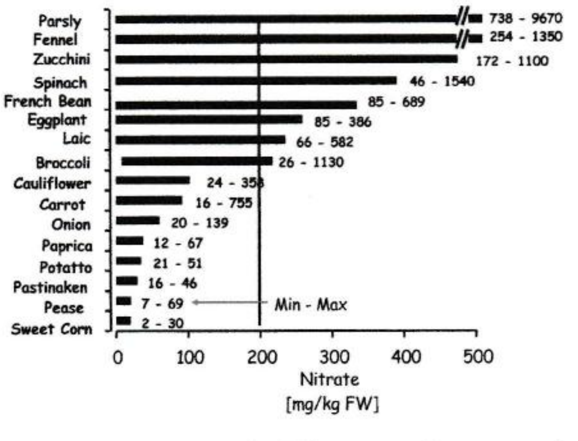

Fig. 1. Range of Nitrate Content in Vegetables

Figure 1 presents the facts of nitrate content of 16 kinds of vegetables needed by the infant food industry (baby food) in Germany and other European countries. Required maximum nitrate content was 200 mg/kg fresh weight (FW), with these requirements there are seven species of vegetables that have average nitrate content higher than 200 mg/kg FW. Into seven types of vegetables namely parsley, fennel vegetable, zucchini, spinach, french beans, eggplant and onion requiring extra effort to reduce nitrate levels. 9 species of vegetables are slightly above and below 200 mg/kg of FW.

Table 3. The Nitrate Upper Limit Some Vegetables for Baby Food Raw Materials

Vegetables	The Nitrate Upper Limit (mg/kg FW)
Broccoli	450
Eggplant	250
Red Chili	100

Source: Nestle, Germany

Genetically, a nitrate content of vegetables varies, vegetables are grouped into three namely: high nitrate, low nitrate and medium.

Table 4. Three Groups of Vegetables with Difference Nitrate Criteria

High Nitrate	Medium Nitrate	Low Nitrate
head lettuce	celery	tomatoes
mustard	carrots	cucumber
spinach	cabbage	paprika
chicory	potato	brussel sprout
lettuce Burger	cauliflower	pease
red radish		
radish		
mangold		
fennel		
Vegetables		
parsley		

Source: Scharpf (1991).

Table 5. The Nitrate Upper Limit for Baby Food Raw Materials

Species	Nitrate Content (mg/kg FW)
broccoli	450
eggplant	250
paprika	100
pease	<100

celery	400
laic	500
bean	300
shallots	100

Source: Nestle (1999)

The average nitrate content of five major types of Indonesian vegetables (spinach, pacoy, cabbage, lettuce and chinakol) a sample taken from the three traditional markets are presented in Table 6 below:

Table 6. The Average Nitrate Content of 5 Vegetables Species Sampled from 3 Traditional Markets

Species	The Average of Nitrate Content (mg/kg FW)		
	Minimum	Maximum	Average
spinach	2,695	10,998	6,427
pacoy	1,472	5,333	3,915
cabbage	824.3	3,192	1,847
lettuce	1,405	1,737	1,553
chinakol	429.5	862.8	704.1

Source: Wijaya (unpublished).

Above species of vegetables (spinach, pacoy, cabbage, lettuce, chinakol) are not eligible for export to European countries for baby food raw materials, because they contain nitrates exceeded the 200 mg/kg of FW. If you want to export a course must be pursued to reduce nitrate levels to 200 mg/kg of FW, therefore, an adequate technology to be required.

Natural nitrate content in vegetable tissues fluctuate because it is caused by many things, so in order to ensure that the vegetables grown will contain nitrate which does not exceed the permitted threshold needed special cultivation technology.

Table 7. The Average Nitrate Content of 5 Vegetables Species Sampled from 3 Super Markets

Species	Nitrate Content (mg/kg FW)		
	Minimum	Maximum	Average
Spinach	3,271	11,646	8,042
Pacoy	1,688	8,620	5,464
Cabbage	1,352	3,986	2,608
Lettuce	1,523	1,953	1,763
Chinakol	1,626	1,784	1,689

Source: Wijaya (2012). FW = Fresh Weight

Table 8. The Range of Nitrate content Some Vegetables

No.	Species	Nitrate Content (mg/kg FW)
1.	red radish	150-5690
2.	spinach	345-3890
3.	lettuce crop	382-3520
4.	radish	261-1186
5.	bean	80-882
6.	cauliflower	62-664
7.	cucumber	20-300
8.	tomatoes	10-100

Source: Venter (1983)

V. NITRATE AND HEALTH

The following will be covered why the levels of nitrate in vegetables included in the criteria of quality? According to toxicology, nitrate compounds are not toxic, but when nitrate is reduced to nitrite (NO_2), then it becomes another issue, because nitrite is a poison that has a blocking mechanism of action of oxygen in the blood. In other words, nitrite causes red blood cells can not bind oxygen. As a result of oxygen supply to the whole body will be disrupted or even stopped, so the body will experience a deficiency of oxygen. Body condition due to lack of oxygen is called *methaemoglobinamie*, nitrite poisoning. Hemoglobin is blocked by nitrite and unable to carry oxygen is called *methaemoglobin*. Clinical symptoms, caused by *methaemoglobin* varies according to levels in the total hemoglobin (Table 9). If there is 10% *methaemoglobin* of total hemoglobin in the blood then the patient will feel weak because the muscles have started to lack of oxygen. The muscles are very weak, bluish skin, rapid heartbeat and shortness of breath when blood *methaemoglobin* levels already in the range of 30-40%. Levels above 40% already may cause death.

Table 9. Level of Methaemoglobin in Baby Blood and The Symptom

Methaemoglobin in Blood (% of Total Haemoglobin)	Symptom
1-2	No symptoms (safe)
10	Weakened muscles
30-40	The muscles are very weak, bluish skin, rapid heartbeat and shortness of breath
40-70	Can cause death

Source: Zakosek and Lenz (1993)

VI. DISCUSSION

According to toxicology, nitrate compounds are not toxic, but when nitrate is reduced to nitrite (NO_2), then it becomes another issue, because nitrite is a poison that has a blocking mechanism of action of oxygen in the blood. In other words, nitrite causes red blood cells can not bind oxygen. As a result of oxygen supply to the whole body will be disrupted or even stopped, so the body will experience a deficiency of oxygen. Body condition due to lack of oxygen is called *methaemoglobinamie*, nitrite poisoning. Hemoglobin is blocked by nitrite and unable to carry oxygen is called *methaemoglobin*. Clinical symptoms, caused by *methaemoglobin* varies according to levels in the total hemoglobin (Table 9). If there is 10% *methaemoglobin* of total hemoglobin in the blood then the patient will feel weak because the muscles have started to lack of oxygen. The muscles are very weak, bluish skin, rapid heartbeat and shortness of breath when blood *methaemoglobin* levels already in the range of 30-40%. Levels above 40% already may cause death. In addition, nitrite derived from nitrate reduction results when reacted with an amine will Formatting nitrosamine. Nitrosamines are compounds that stimulate the formation of cancer cells.

Statistics show that 72.4% daily nitrate intake comes from vegetables, equivalent to 35.7 mg / day. Epidemic studies on the correlation between nitrate intake with colorectal cancer risk in some countries such as Chile, China, Columbia, Denemark and Italy showed a positive association between nitrate intake and colon cancers (Preussmann (1993). Nitrate is consumed by humans comes from vegetables more than 70%, comes from drinking water is 15% and the rest from other foods that contribute little. Genetically vegetables have different levels of nitrate, so that according to the content of nitrate, vegetables are grouped into three namely: high nitrate, low nitrate and nitrate medium (see Table 4). Because each type of vegetable has different nitrate content in nature, then rule on the maximum threshold differentiated according to each type of vegetable (see Table 2).

Some of the efforts made by WHO and the German government to limit the consumption of nitrate. WHO makes the maximum daily intake of 220 mg of nitrate, while the German government to impose more stringent limits are 130 mg (Wehrmann and Scharpf, 1985). Except from vegetables (72.4%), nitrate is also derived from drinking water. For the restriction of nitrate levels in drinking water are also performed. USA imposed a limit of the highest nitrate levels of 25 ppm, 50 ppm while the Germans in force since 1985. While UniEropa impose the same limit is 25 ppm with the USA. Of this restriction is expected to avoid the danger of nitrate.

Indonesia is still not aware nitrate hazard to health so that rules that limit daily intake of nitrate and nitrate content of vegetables restrictions does not exist. Restriction of nitrate in drinking water was already there are 10 ppm, but this rule was never socialized and have not been implemented properly.

The absence of rules and restrictions on nitrate levels also uncontrolled nitrogen fertilization on vegetable crops, it can be presumed that the nitrate content in vegetables produced by farmers Indonesia can be high. Wijaya (2012) reported that the 5 types of vegetables that were analyzed (spinach, pacoy, cabbage, lettuce and chinakol) contain high nitrate respectively 6427, 3915, 1847, 1553, and 704 mg / kg FW) (see Table 6 and Table 7). When associated with a maximum daily intake of nitrate released by the WHO of 220 mg nitrate/day and the WHO recommendation for an annual minimum consumption of vegetables is 75 kg/person/year which is equivalent to 208.3 g/day, the daily nitrate intake when eating spinach, pacoy, cabbage, lettuce, and chinakol respectively 1285, 783, 369, 310 and 140 mg nitrate/day.

Vegetables of the above would be difficult to export to European countries because of strict requirements of nitrate levels. Without adequate production technologies, Indonesian vegetables will remain only as a commodity that does not have to trade competitiveness in european markets.

VII. CONCLUSSION

European countries imposed a very strict requirement of nitrate, the Indonesian vegetable will be difficult to get into the European market.

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