

## PEPPER - VIETNAMESE SPICY FLAVOR

### 1. Introduce

Pepper (*Piper nigrum*) has been cultivated in Viet Nam since the 17<sup>th</sup> century but pepper production only really thrived after 1997 when pepper prices in the market increased rapidly.

Vietnamese pepper industry is known as the world's No. 1 producer and exporter, which is a prestigious and quality commodity. Moreover, Vietnamese pepper is also a potential and promising market.

In Vietnam, wild-growing pepper trees were found before the sixteenth century, but were not put into cultivation until the seventeenth century. By the end of the nineteenth century, pepper was cultivated in a relatively large area in Phu Quoc, Hon Chong and Ha Tien (Kien Giang), mainly because the original Chinese of Hainan Island followed Mo Jiu to migrate to Ha Tien. Also around this time and in the early twentieth century, pepper trees followed French plantation owners to Binh Long, Ba Ria-Vung Tau, Quang Tri and Quang Nam.

The remarkable development of pepper began in the years 1983-1990 when the price of pepper on the world market increased. Vietnam's cultivated area has continuously increased and reached nearly 9,200 hectares from 400 hectares in the 1970s. With an average growth rate of 27.29% per year since 1996, Vietnam's cultivated area exceeded 50,000 hectares in 2004. Over the past years, from the end of 2008 until now, when pepper prices doubled in previous years and by 2011, pepper prices have reached a record of 5,500-5,800 USD/ton for black pepper and 8,000-8,500 USD/ton for white pepper, increasing the pepper planting area rapidly. By the end of 2013, Vietnam's pepper plantation area had reached nearly 60,000 hectares.

In line with the rapid development of area and output, since 1998, Vietnam's pepper exports have also increased rapidly at an average rate of 15-20% per year. In 2001, Viet Nam became the world's largest exporter with total exports reaching 56,506 tons, accounting for 28% of the world's total exports. Since then, Viet Nam has continuously been the leading country in production and export with pepper production. From 2009 to 2013, exports averaged 120,000 -125,000 tons per year. According to the General Department of Viet Nam Customs, in the first 8 months of 2023, Viet Nam has exported

188,059 tons of pepper, turnover reached 615.5 million USD, when being compared to the same period last year, exports increased by 17.0% in volume but decreased by 13.8% in value.

The reason why Vietnamese pepper can develop so remarkably is because Viet Nam has all favorable conditions in terms of nature, people, application of science and technology in production and processing pepper. Nature endows with fertile basalt soils, subtropical climate, high humidity, abundant rainfall. Vietnamese farmers are industrious, hardworking, eager to learn. The Vietnamese government and scientists are ready to assist in investment in cultivation and application of science and technology. Processors and exporters always actively expand markets, invest in modern processing plants, diversify products. Besides, there is Viet Nam Pepper Association established in 12/2001, a non-profit unit that always works actively and effectively for the benefit and development of Viet Nam pepper industry.

Viet Nam joined the International Pepper Community (IPC) in 2005, Viet Nam Pepper Association was assigned by MARD to directly participate in IPC activities, sharing industry information on the price market, applying advances in pepper cultivation techniques according to sustainable organic methods (GAP) in terms of quality standards. In 2022, the global pepper area was 745,000 hectares, an increase of 42.8% compared to 2020. In Vietnam, pepper area decreased significantly due to sharp price drops, the impact of epidemics and climate change, from 152,000 hectares in 2017 to 130,000 hectares in 2021 (According to Viet Nam Pepper Association information at the Viet Nam International Pepper Industry Conference, 2022).

Vietnamese pepper has been exported to 120 countries and territories. Especially the export of high-quality goods to the US and EU countries is increasing. The largest export market of Vietnamese pepper is China, followed by other major markets of Vietnamese pepper such as the United States and Europe. The Chinese market mainly imports black pepper, up to 90% whole grain black pepper, the remaining 10% is ground pepper. Europe and the United States are the world's largest importers of black pepper, accounting for about 1/3 of global imports.

**\* Popular pepper varieties in Vietnam**

- ***Vinh Linh pepper variety:*** Vinh Linh pepper variety originated from Quang Tri province.

- ***Lada Belangtoeng variety***: This is an Indonesian pepper variety imported into Viet Nam since 1947.

- ***Se pepper varieties***: Pepper varieties are grown in many localities and are called under the following names: Loc Ninh pepper, Ba Ria pepper, Dak Lak pepper.

- ***Indian pepper variety***: Originally from India, it was grown in Ba Ria red soil for a long time, then some other localities such as Binh Phuoc, Dak Lak, Gia Lai brought it back to plant.

- ***Phu Quoc variety***: According to Phan Huu Trinh, the variety originated from Cambodia.

- ***Buffalo pepper variety***: A local variety in many pepper-growing regions of our country.

### \* **Benefits of pepper**

#### *Nutritional value and benefits to consumer health*

In pepper there are essential oils: 1.2-2%, piperin: 5-9% and chanvixin: 2.2-6% (Piperin and chanvixin are two types of alkaloids with a tar taste that makes pepper spicy), fat: 8%, starch: 36% and ash: 4%.

Pepper is also rich in vitamin C, even more than tomatoes. Half a cup of green, yellow or red pepper will provide more than 230% of calcium needs per day per person.

Black pepper is the fruit of the pepper tree (*Piper nigrum*), which is not only the spice that gives the appeal of the dish, but also has many health benefits. Black pepper contains a chemical called piperine, which gives pepper a pungent flavor and is a potent antioxidant. It is this active ingredient that gives black pepper many health benefits such as: Relieves pain, improves breathing and reduces inflammation ...

+ Effects on the digestive system: Help eat better, limit anorexia, enhance the absorption of nutrients in food. Stimulating the stomach, promoting the digestive process to help limit indigestion, bloating, flatulence, stomach discomfort.

+ Antibacterial effect: Pepper has a high antibacterial effect against respiratory infections, gum problems such as cavities, gingivitis ...

+ On the nervous system: Helps improve mood, reduce stress and fatigue due to substances that make the body increase serotonin production.

+ Help lose weight and maintain physique: The substances in pepper husks help the body eliminate excess calories, increase the excretion of excess sweat and water through the urinary tract. Therefore, if you use a little outer skin of pepper before starting sports training, it will increase the effectiveness of removing excess fat.

+ According to traditional medicine, pepper has a spicy taste, great temper, has anti-welding, antibacterial, analgesic, expectorant effects. So it is used to treat abdominal pain caused by cold, diarrhea, cold hands and feet, vomiting, cold cough ...

### *Economic and cultural values*

- Pepper is a crop that brings economic value, and it is one of the main agricultural export products of our country. It is being developed in the right direction and sustainably pepper trees have great economic significance, contributing to the economic growth of the country in general, the economy of the region and locality in particular as well as contributing to poverty reduction, improve the lives of farmers

- Pepper is not only a spice used in food processing for a long time, is a direct fruit (green pepper), but also used to marinate and making dishes.

### **\*Pepper products**

Products such as: black pepper powder, green pepper powder, green pepper sauce, lemon leaf salt and pepper, cranial pepper (white pepper), green pepper ...

## **2. Pepper growing area and production capacity in Vietnam**

Pepper is planted from Nghe An to the south, a total of 18 provinces have pepper with planting area of over 100 hectares. Pepper is also scattered in some other provinces with a total area of about 650 hectares. Among the pepper-growing regions, the two regions with the fastest growing pepper area are the Southeast and the Central Highlands.

In the Southeast region, only two provinces of Binh Phuoc and Ba Ria-Vung Tau, the total pepper area reaches about 21,000 hectares, the three Central Highlands provinces with large pepper areas are Dak Lak, Gia Lai and Dak Nong, the province with a large pepper area in the North Central is Quang Tri and in the South Central Coast is Binh Thuan.

### **2.1 Binh Phuoc pepper growing area**

In 2003, the pepper area of the province reached about 14,195 ha, of which the harvested area was 8,350 ha, the output reached 19,010 tons. By 2004, pepper area decreased by 4.4% (13,571 ha), due to low pepper prices in recent years and high prices of materials and labor, in addition to pests and diseases that were also a cause of the reduction of pepper area in the province. Although the total area has decreased, the pepper harvest area increased by 19.6% (10,389ha) in 2004 as new pepper orchards planted between 1997 and 2002 were harvested, the output increased by 23.7% (24,933 tons) compared to 2003.

In Binh Phuoc, pepper cultivation area is concentrated mainly in Loc Ninh (3,758 ha), Binh Long (3,519 ha) and Bu Dop (1,149 ha), the remaining districts have pepper cultivation but the area is negligible (Binh Phuoc Statistics Office, 2005). The average pepper planting area per household is about 0.5-1.0 hectares, but there are many households with pepper planting area of 2-3 hectares and especially households up to several hectares.

## **2.2 Ba Ria-Vung Tau pepper area**

Most districts in the province have pepper cultivation (Con Dao district alone has a small area). However, pepper area is concentrated mainly in some districts such as Chau Duc (5,330.5 hectares), Xuyen Moc (1,244.7 hectares), Tan Thanh (366.5 hectares), and Ba Ria town (263.5 hectares). These are localities with a large area of basalt red soil, suitable for pepper plants to grow. The remaining urban districts have insignificant pepper areas. In Ba Ria-Vung Tau, the difference in area between households and regions is also very large, the average area per household is about 0.4 ha. Total pepper production in the province in 2003 reached 9,911 tons, mainly from pepper growing in large areas.

The area of new pepper plantation increased the most in Chau Duc district (1,192.3 ha), in other localities the new planting area increased insignificantly. The area of pepper destroyed was mainly in Xuyen Moc (188 ha) due to a fast-dying infection area by *Phytophthora* causing mass loss a few years ago. Some gardens with irreparably severe illness were forced to destroy the plants and convert to cashew planting.

From 2001 till now, pepper area has the tendency to decrease, from 8,413 hectares to 7,246 hectares in 2003. The reason for the decrease in acreage is that pepper prices are low, which does not stimulate farmers to plant new crops, and some acreage is converted to other crops.

## **2.3 Central Highlands**

### **Natural conditions**

The Central Highlands has a tropical monsoon climate divided into two distinct seasons, the rainy season and the dry season. The rainy season is started from May 5

and lasts until October, the dry season from November to April the following year. The average annual rainfall is 1800 mm, mainly distributed during the rainy months. The dry season lasts 5-6 months, so active irrigation is essential to expand agricultural production. The heat and humidity regime is generally suitable for many crops to grow and is suitable for the ecological requirements of pepper plants. High day and night temperature amplitudes are favorable conditions for the accumulation of aromatics for some types of agricultural products.

In the Central Highlands, the land has a steep hilly terrain occupying more than 85%, the surface is open, less divided, convenient for organizing, managing and producing agriculture as well as business. The main crops in the Central Highlands are mainly rubber, coffee, pepper and cashew. There are also fruit trees, hybrid corn, beans, rice.

The Central Highlands has five main land groups:

- Reddish-brown feralite soils grow on alkaline and neutral magmatic rocks, also known as basalt soils, with arable soil layer more than 1m thick. Layer A is reddish-brown or dark brown, organic content is quite high, mechanized composition is light or medium. This type of soil is quite fertile, suitable for many valuable industrial and fruit crops.

- Red-yellow feralite soils grow on acid magma (Fa) rocks, which are distributed over low-mountain, plain, and hilly terrains. The topsoil is less than 50 cm, often mixed with gravel. Decent organic content, light or medium meat mechanized composition, acidic soil.

- The other three soil groups are red-yellow feralite growing on shale or metamorphic rock, riverine or foothill slope alluvial soils and low-lying wetlands.

Most of the pepper area is grown on flat or slightly sloping basalt soils. This type of soil is ideal for industrial crops due to its thick, well-drained and quite fertile arable floor.

### **Socio-economic conditions**

The Central Highlands region has a total area of 54,473 km<sup>2</sup> with a population of 4,674,200 people and a population density of about 86 people/km<sup>2</sup>. It has a population of 3,405,800 in rural areas.

According to the data of 2001 statistical yearbook, the population of Chu Se was 112,500 of which the Kinh ethnic group accounted for 46.5% of the rest were Ja Rai, Ba Na and other ethnic groups. Kinh people live concentrated in the town and residential areas along National Highway No.14 and National Highway No.25. A large part of the Kinh ethnic group are households that went to build a new economy according to the government plan and people who migrate freely from the north. Most of the labourers are engaged in agriculture, mainly in coffee and pepper cultivation,

working as workers in rubber plantations, animal husbandry and combined trade. Ethnic villages are often far from roads, life is still difficult, education is low, often living according to the local customs and customs of each small community. Most ethnic households grow short-term crops for self-sufficiency in food, such as rice, corn, cassava, gourds and legumes.

Agriculture and forestry is the main economic direction of Chu Se district, in which cultivation is an important field and accounts for a large proportion. Chu Se has a flat terrain favorable for production and business, with National Highway No.14 as a traffic artery and National Highway No.25 running through made it more convenient for trade and exchange of goods with the Central Coast provinces and the southern provinces. Chu Se's main commodities are coffee, pepper, rubber, food and fruits. The transportation of goods is very convenient.

The life of Chu Se people has been improved, the average per capita income has increased markedly, in the period 1999-2000 the average increase was 20.1 USD/year. In fact, in a large part of the population, life becomes well-off, many wealthy households have produced billions of dong. However, another segment is still in poverty, especially ethnic households with low per capita income. The district has also made reasonable policies to reduce poverty, paying special attention to improving the lives of ethnic minorities, strengthening infrastructure for disadvantaged communes.

### **Pepper production**

Pepper is a crop that creates jobs, bringing the main source of income to tens of thousands of farming households in Chu Se district. Among the Central Highlands provinces, Chu Se district of Gia Lai province is one of the districts with the largest pepper area in the region. According to the 2003 statistical yearbook, Chu Se district has 1,825 hectares of pepper with a total output of 5,020 tons of black pepper. However, the actual area is much higher. According to estimates by the district Economic Department, unofficial data on pepper area is up to 3,000ha, the output in the last 2005 crop was estimated at up to 10,000 tons of black pepper.

Pepper is produced in the form of household production with a scale from a few hundred pillars to several thousand pillars, an average of about 1,000-2,000 pillars, especially households over 10,000 pillars. However, this number is very small and only accounts for about 1.5% of the total pepper farming households of the district. Due to the huge initial investment cost, most farmers plant and expand the area gradually over the following years. Often in a pepper garden there are 2-4 years of age trees. In general, the pepper gardens in Chu Se are quite young. Young pepper orchards under five years old in Chu Se account for a high proportion in some communes such as Nhon Hoa, IaBlang and Chu Se Township. Proving that the pepper

area has expanded quite quickly in recent years. Young pepper orchards will achieve high yields in the following years and this will be an abundant source of pepper.

#### **2.4 Quang Tri pepper area**

From September to November, due to the influence of the Northeast monsoon, there is usually drizzle that lasts until February next year. The rainy season here is often affected by heavy storms along the central coast, the drop in air temperature affects the growth and development of crops, which is typical of the climate of Quang Tri in the delta districts. Particularly, Huong Hoa district's climatic conditions are somewhat milder because it is dominated by the climate of the Western Truong Son region. Here the rainy season comes earlier, the rain is scattered evenly from the end of April to November, the average air temperature of this region ranges from 18.2-25.6<sup>0</sup>C, the maximum temperature is only 35.7 0 C. However, the period of such high temperature does not last as long as some other pepper growing areas of Quang Tri such as Cam Lo, Vinh Linh or Gio Linh, the low evening temperature is not less than 12<sup>0</sup>C on some days of January 1, 2, 3 and does not last long, so the weather in this region is quite favorable for some industrial crops such as coffee, pepper, rubber.

The soil for pepper cultivation in Quang Tri is mainly red-yellow or yellowish-brown soil growing on basalt. Some communes in Vinh Linh, Cam Lo, Gio Linh districts grow pepper on shale and sloping soil. Pepper land of districts is mainly concentrated in hilly areas, so any district with a large area of hilly land has a higher ratio of pepper plantation area to natural land area than other districts.

The area and ratio of pepper plantations to natural land ranges from only 2.56-14.0%. The district with the largest area is Cam Lo district (922 ha) accounting for 14% of natural land. Particularly, Huong Hoa district, although the area is hilly and mountainous, natural land and agricultural land is larger than Cam Lo district, the pepper planting area is not large because most of it is forest land, agricultural land compared to natural land only accounts for 10%, on the other hand, pepper cultivation has not become traditional like other places. In addition, the proportion of ethnic minorities is quite large and they are not used to the cultivation of perennial industrial crops. The pepper plantation area in this region focuses mainly on Kinh families who went to build a new economy.

#### **Socio-economic conditions**

Quang Tri is one of the provinces located in the Central Coast region of Viet Nam with an area of 4,745km<sup>2</sup>, a population of about 616,600 people and a population density of 130 people/km<sup>2</sup>. According to the 2004 statistical yearbook, the population in rural areas is 466,000 people, this is one of the advantages to meet the labor needs of the province in general as well as the development of the agricultural industry in particular.



## **Agricultural production**

Quang Tri has a total natural land area of 474,600 hectares including agricultural land, forestry land, special-use land and residential land. Among the above four land groups, land used for forestry accounted for the highest proportion, reaching 33.7% (160,300ha), followed by land used for agricultural production about 73,800ha, accounting for 15.5% of the province's land area. Although the land area for agricultural production accounts for a relatively high proportion, the average area per farmer household is low, about 0.57 ha/household. For Quang Tri farmers, in addition to the practice of growing short-term crops such as rice, corn, potatoes, cassava, perennial crops are also invested by people such as coffee, tea, rubber, pepper, mulberry and tobacco.

### **Pepper production**

The pepper area of Quang Tri in 2001 was 2,025 ha, every year new planting area was added, but the increase in the area of the regions was not large, only about 100-200 ha/year. The additional area is mainly concentrated in key districts such as Vinh Linh, Gio Linh and Cam Lo, other districts the annual expansion area is insignificant. The area size in 2004 was 2,484 hectares and was almost stable at this figure. Among the pepper-growing districts in Quang Tri, Cam Lo district is one of the districts with the largest pepper growing area, accounting for 14.1% of agricultural land. The average pepper planting area in Quang Tri is about 0.3 ha/household. The difference in area between households is quite large. The pepper area at the harvest stage ranges from 1,000-1,500 hectares and focuses mainly on Vinh Linh, Gio Linh and Cam Lo districts. Other districts, on the one hand, because the land fund for pepper trees is limited, on the other hand, in recent years, the price of pepper in the market is low, so pepper has only grown moderately.

Quang Tri pepper yield is lower than that in the Southeast and Central Highlands regions, reaching only 10.3 quintals per hectare in 2000. In recent years, yields have tended to increase quite clearly, reaching 13.4-13.8 quintals/ha in 2003 and 2004. Due to the insignificant increase in pepper area in recent years, pepper farmers have a higher chance to invest in intensive cultivation on their existing pepper orchards. Although the pepper area increased insignificantly, thanks to the good increase in productivity, pepper production in 2004 increased 2 times compared to 2000 and 2001.

### **2.5 Phu Quoc pepper area**

#### **Natural conditions**

- Average annual rainfall of 2,950 mm, concentrated from May to October, with 81.5% of total rainfall for the whole year.

- Annual evaporation (measured in Piche) 1,165mm, highest in December and lowest in October.

- The average annual humidity is 82%, the humidity gradually increases from May and starts to decrease from October, the month with the highest humidity is September.

- Total sunshine hours for the year 2,302 hours, concentrated in January to April, the month with the highest number of sunshine hours is March.

- Average annual temperature 27.3 °C, highest temperature 34.5 °C in March and April, lowest temperature 19.1°C in January.

Phu Quoc district is an archipelago located in the extreme southwest of the western sea of our country, with geographical coordinates of 103.8-104.1 degrees East longitude, 10-10.4 degrees North latitude. The island has a triangular shape, wide in the North and gradually narrowing in the South, the largest length in the North-South direction (49km), the largest width in the North Island (27km), the circumference of the island is about 150km.

Phu Quoc island district has a total natural land area of 59,305 hectares, of which 7,761 hectares are agricultural land. The land for pepper cultivation in Phu Quoc is largely reclaimed from hills and mountains, including gray soil on acid magma rock, sandstone, gray soil with red-yellow patchy layer and light yellow soil on sandstone. Phu Quoc soil is poor in nutrients, sand accounts for a high proportion in mechanized composition, organic matter from 1.0-1.4%, acidic soil, pH<sub>KCl</sub> 5.1, **total N** content 0.08-0.12, P total 0.03-0.04 and K **total** 0.02-0.09 (Southern Institute of Agricultural Planning and Design, 1999).

### **Socio-economic conditions**

In the district, there are positive changes in many economic sectors. However, the two sectors of agriculture and fishery, which were the strong sectors of the district are in a downward state, especially the agricultural sector. With the results of many periodic surveys and other surveys in coordination with information collected from agencies and mass organizations, the Department of Statistics estimated that GDP increased by 8.99% in 2004, but did not meet the plan due to many reasons, notably the fishery sector, being the main economic sector, decreased by 3.61%, the agriculture and forestry sector decreased by 5.8%.

### **Pepper production**

Pepper is the main crop of the island district, Phu Quoc pepper products have been famous at home and abroad for a long time. Like other pepper-growing localities, the district's agricultural sector is facing many difficulties due to the continuous and

low price of pepper in recent years, forcing farmers to sell land to get money to pay off bank debts and ensure family life.

In Phu Quoc, pepper is concentrated in three communes: Cua Duong, Cua Can and Duong To. In 2001, the pepper area of the whole district was 77.5ha, reaching an output of 1,690 tons, by 2004 the area decreased by 245 ha to only 530ha, with an output of 1,364 tons (Phu Quoc District Statistics Office, 2004). According to preliminary results compiled from the recent pepper tree survey, pepper area decreased the most in Cua Can commune with 90.1ha, Cua Duong commune decreased by 90ha and Duong To commune decreased by 48.6ha. Due to the decrease in area, only about 24ha of newly planted pepper since 2003 has not been harvested, most of the remaining area has been harvested with an average yield of about 2.7 tons /ha, lower than the average yield of over 3.0 tons / ha in the years 2001-2002, mainly due to reduced investment and care.

### 3. Pepper production in Vietnam

#### - Climate and ecology

+ **Temperature:** The suitable temperature for pepper plants is from 20 - 30°C. When the air temperature is higher than 40°C and lower than 10°C, it adversely affects growth.

+ **Light:** Light scattering is suitable for physiological requirements of growth and development, fruiting of pepper trees and prolongs the life of the orchard.

+ **Precipitation and humidity:** Pepper plants prefer hot and humid climatic conditions. Pepper also needs a relatively short drought period after harvest for good flower germination and mass flowering. Pepper plants need a high air humidity of 70-90%, especially during the flowering period.

+ **Wind:** Pepper plants prefer calm environments, or light winds. Hot winds, cold winds, storms are not suitable for pepper plants.

+ **Land:** Pepper trees are suitable for soil terrain conditions with a gentle slope of 5-100 because it is convenient for setting up drainage systems in pepper gardens. In Vietnam, pepper trees have been grown on many different types of soil such as: Basalt red soil (Central Highlands and Southeast region), Sandy clay soil (Ha Tien, Phu Quoc), Alluvial soil (Mekong Delta) + Grey soil (Southeast Vietnam) ...

#### - Cultivation technical process and pest control

+ Seedling standards:

- The plant is nursed for 4-5 months in the nursery, with at least 1 bud bearing 5-6 leaves or more newly planted.
- Plants are pest-free and trained with 70-80% light 15-20 days before planting.

+ Fertilizer dosage

**Table 1. Quantification of chemical fertilizers for pepper (g/pillar/year)**

Year	Use NPK fertilizer (kg/ pillar)		Use single fertilizers (g/ pillar)			
	Kind	Dosage	Urea	GAUZE	Lan Van Dien or Super	KCl
<b>New planting</b>	16-16-8	200 - 250	80	20	500	10
<b>Year 2</b>	16-16-8	500 - 600	200	70	500	20
<b>Year 3</b>	16-16-8	800 - 900	300	100	500	30
<b>Business</b>	16-8-16	1100 - 1250	350	150	500	35

+ Main types of pests and diseases:

- Yellow leaf disease (slow-dying disease)
- Rapid death caused by the fungus *Phytophthora*
- Leaf mosaic and leaf curl disease (Stunted disease)
- Anthracnose (*Colletotrichum Gloeosporioides*):
- Black leaf disease (*Lasiodiplodia theobromae*)
- Leaf spot
- Mealybug (*Pseudococcus citri*):
- Stem borer

+ Packing, quarantine treatment for export

- Harvesting: Ripeness standards when harvesting to serve processing as required

STT	Product	Harvest ripeness
-----	---------	------------------

1	Brine/canned pepper	Being green and not yet hardening seeds (about 4-5 months after flowering)
2	Black pepper	Fully ripe with already firm pepper, on the bunch of fruits 1-2 fruits begin to turn yellow (reaching >15% of the fruits turn yellow)
3	White pepper	Fully ripe, on the bunch of fruits at least 2-3 fruits begin to turn red.

The physicochemical, chemical and microbial indicators of processed black pepper for export are recorded in the following tables:

**Table 2: Physical indicators of black pepper**

Indicator name	Required level:				
	NP or SP black pepper				Processed pepper
	Special Kind	Kind 1	Kind 2	Kind 3	
1.Foreign impurities, % mass, not greater than	0,2	0,5	1,0	1,0	0,2
2.The grain, % by mass, not greater	2	6	10	18	2,0
3.Nail-tipped or broken grain, % by mass, not greater than	2,0	2,0	4,0	4,0	1,0
4. Mass by volume, g/l, not less than (Capacity)	600	550	500	450	600

**Table 2: Chemical indicators of black pepper**

Norms	Request level		
	NP or SP black pepper	Pepper was process	Peppercorn flour

1. Humidity, % mass, not greater than	13,0	12,5	12,5
2. Total ash, % mass according to dry matter, not greater.	7,0	6,0	6,0
3. Ether extractor is non-volatile, % of mass in dry matter, not less.	6,0	6,0	6,0
4. Oil evaporation, % (ml/100g) in dry matter, not less.	2,0	2,0	1,0
5. Piperin, % by mass in dry matter, not less.	4,0	4,0	4,0
6. Ash is insoluble in acid, % mass in dry matter, not greater.	-	-	1,2
7. Coarse fiber, insoluble index, % mass in dry matter, not less.	-	-	17,5

**Table 2: Microbial indicators for processed black pepper**

<b>Indicator name</b>	<b>Limit level</b>
1. Coliform, the number of bacteria in 1g of product	$10^2$
2. E.coli, the number of bacteria in 1g of product	0
3. Salmonella, colonies in 25g of product	0
4. S. aureus, the number of bacteria in 1g of product	$10^2$

**Table 4: Physical indicators of white pepper**

Indicator name	Request level	
	SP Pepper	Pepper P
1.Foreign impurities, % bulk, not greater.	0,5	0,2
2.The grain, % by mass, not greater.	4,0	2,0
3.Nail-tipped or broken grain, % by mass, not greater.	15	10
4.Mass by volume, g/l, not less.	600	600

**Table 5: Chemical indicators of white pepper**

Norms	Request level	
	SP or P pepper	Pepper powder
1. Humidity,% mass, not greater.	13,0	12,5
2.Total ash, % mass according to dry matter, not greater.	3,5	3,5
3.Ether extractor is non-volatile, % of mass in dry matter, not less.	6,5	6,5
4.Oil evaporation, % (ml/100g) in dry matter, not less.	1,0	0,7*
5.Piperin, % by mass in dry matter, not less.	4,0	4,0
6.Ash is insoluble in acid, % mass in dry matter, not greater.	-	0,3

7.Coarse fiber, insoluble index, % mass in dry matter, not less.	-	6,5
--	---	-----

\* *Evaporated oil should be determined immediately after grinding*

Microbial norms of white pepper are similar to processed black pepper

**+ Current export pepper quality standards**

- FAQ (Fair Acceptable Quality) standard:

Usually export the following types:

+ FAQ black pepper 550g/liter: Capacity: 550g/liter; Humidity:12.5%; Impurities:0.5%;  
No vermin, mold.

+ FAQ black pepper 500g/liter: Capacity: 500g/liter; Humidity:13%; Impurities:1%; No  
vermin, mold.

- **ASTA** (American Standards Trade Association)

+ Capacity: 570g/liter for black pepper and 630g/liter for white pepper

+ Humidity:  $\leq 12.5\%$  + Animal waste:  $\leq 1\text{mg/lb}$  (454g)

+ Impurities:  $\leq 1\%$  + Other waste:  $\leq 5\text{mg/lb}$

+ Light seeds:  $\leq 2\%$  + Pests:  $\leq 2$  animals/lb

+ Mold:  $\leq 1\%$  + Salmonella: None

+ Grain size on sieve  $\phi$  5mm: 100% + Pepper is cleaned with hot steam

In addition, some markets in Europe and the Middle East also require very high food safety standards, requiring no heavy metals such as lead, Arsenic, Cadmium, no E-coli, radioactive substances, etc.

More than 95% of Vietnam's pepper production is now exported according to FAQ standards, with a capacity of 500-550g/liter, moisture content from 13-13.5% and impurities from 0.5-1%. The export volume according to ASTA standards accounts for a insignificant proportion.



**+ Phytosanitary treatment measures have not been applied to pepper products exported to the European market**