Determination of Navel Orange Safety Production Traceability Information Based on HACCP

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Abstract: The traceability system of navel orange can ensure the quality and safety due to the whole process control from orchard to market. Research on the whole process of navel orange is the foundation and premise of building the traceability system. Based on the analyses of whole food chain of navel orange from origin to market, HACCP is used to evaluate the risk and latent risk of the food chain of navel orange: planting, harvesting, processing, packing, transportation and sale, the critical control point of navel orange were fixed. Further, the traceability information of the navel orange traceability is determinate finally.

Keywords: navel orange; critical control point; traceability information; HACCP

1 Introduction

After several food safety related issues, particularly several food sandals, the global food industry and governments in many countries have paid more and more attention to traceability systems for the food chain [1]. There are three meaning to construct traceability systems: one is to give consumers the right to know, the second is to strengthen the responsibility for the enterprises which produce food, and the third is to find the root causes when the food safety issues happened [2].

Navel orange is one of characteristic agricultural products in the middle of china, which is demanding climate for growing. The origin of the navel orange mainly existed in south Jiangxi province, zigui, Hubei province, fengjie, Chongqing province, binzhou, Yunnan province. Gannan is the advantageous product area for navel orange determined by ministry of Agriculture in China. Gannan is the famous base for navel orange, where is known as "town of navel orange in China". Many counties in Gannan have taken navel orange as an important tool for local farmer income. The navel orange produced in Gannan has many unique features, such as large shaped, bright color, crisp flesh and good taste.

However, the incidents occurred in recently years, such as "dyeing navel orange" in Hong Kong in 2004, "bactrocera minax" in guangyuan city, Sichuan province in

2008, have damaged the orange industry in south of china. For example ,the “dyeing navel orange” incident made 70% order in Hong Kong cancellation, the price of navel orange fell sharply in 2004. In 2008, affected by the “bactrocera minax” incident, all of the consumers don’t want to buy navel orange in china. These events cause severe economic losses to fruit growers.

In order to guarantee the quality safety of navel orange, make sure the quality safety information can be tracked and traced, we should monitor the whole process from tree planting to sale [3], which also called “management from orchard to table”. As for navel orange, confirm the critical control point based on the analysis of the whole process from tree planting to fruit processing with the HACCP (Hazard Analysis and Critical Control Point)[4] is the foundation of traceability system construction.

2 Navel orange production process analysis

2.1 Navel orange production process from orchard to market

Generally, there are 11 steps from navel orange tree planting to navel orange fruit sale on market: orchard selection, sapling selection, planting, tree management, soil fertilizer and water management, flower and fruit management, insect control, harvest, washing and packing, storage and transportation [5]. The whole process is shown as Fig. 1.

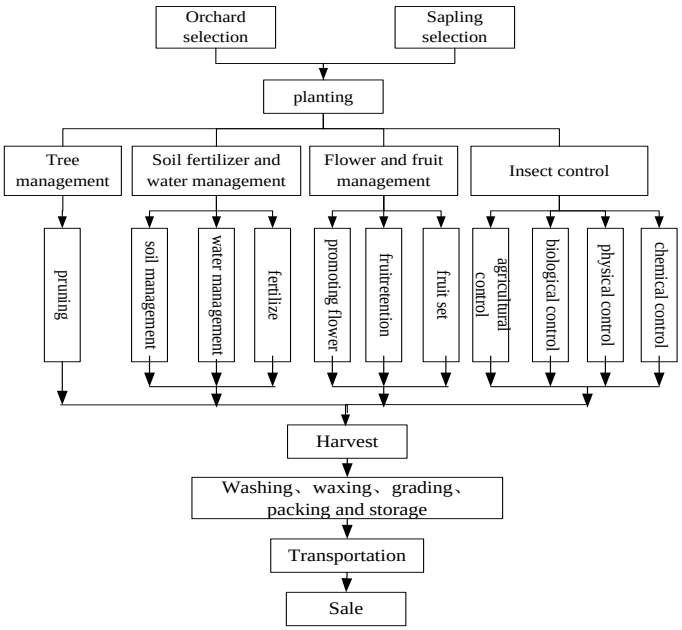

Fig. 1. 11 steps of navel orange growing

It needs 2-3 years from tree planting to bear fruit for navel orange tree, and it needs 280-300 days from blooming to outcome for navel orange. There are a lot of links and elements affect the quality safety for navel orange.

2.2 Navel orange main hazard analysis

Generally, there are three kinds of hazard to person in fresh agricultural products: biological hazards, chemical hazards and physical hazards.

The biological hazards of navel orange mainly refer to the biological itself and its metabolites will pollute fruit raw materials, process and products. This pollution will damage consumer's safety. As for fruit, hazard generated creatures are fungi, bacteria, viruses, natural toxins, parasites. Specifically, ulcers are the most occurred bacterial diseases for navel orange, which damage a lot to navel orange.

The chemical hazards of navel orange mainly refer to chemical substances, residues and emissions generated by human activities, which contaminated the fruit. Chemical hazards involves a broader range, including environmental pollution, pesticide residues fertilizer residues, chemical element pollution, packaging materials, such pollution damages the health of consumers. For navel orange, atmospheric pollutants are same with other fruits, including total suspended particulates, sulfur dioxide, nitrogen dioxide, and fluoride. Soil contaminants in navel orange include heavy metals, toxic substances (pesticides, various chemicals) and other pollutants. Soil pollution comes mainly from three aspects: First, the discharge of industrial waste; second pesticide, fertilizer application, etc.; third of sewage irrigation.

Physical hazards of navel orange exist in fruit with potentially harm may cause bodily injury to consumers., which are common glass, wire, nails fragments, stones fragments, metal fragments and so on.

3 Analysis of Navel orange critical control point for safety production

3.1 Navel orange safety element analysis

As we known, navel orange can be sold on market after 11 steps. Among all of these process, potential hazard factors include: environmental conditions, water quality, pesticide residues, etc, which we should analyses detailed from biological hazards, chemical hazards and physical hazards three aspects, then identify the significant hazards [6].

Chemical hazards that can impact navel orange safety mainly in the following five areas: first , pesticide residues as well as mercury, cadmium, lead, tin, chromium, arsenic, fluoride and other harmful substances residues in soil; second, fluoride and sulfide in air; third, pesticide residues and mercury, cadmium, lead, tin, chromium,

arsenic, fluoride residues in irrigation water, fourth, mercury, cadmium, lead, tin, chromium, arsenic, fluorine, and antibiotics residues in fertilizer; fifth, pesticides and heavy metals exceeded in the fruit during the pest control process.

There is no physical hazard to customers in navel orange basically.

3.2 Critical control points of navel orange

Based on the whole process of navel orange and information of hazard analysis, five critical control points was determined (shown in Table 1):

(1) Surroundings, soil properties, pesticide residues and harmful substances in the orchard.

(2) Pesticides in the pest control.

(3)Disinfectant and wax during the washing, waxing.

(4) Pathogens during transportation

(5) Pathogens in market.

Table 1. HACCP based Hazard analysis of navel orange

Production process	Hazard type	Is significant?	Judgments based on the third column	Precaution	Is CCP?
Orchard selection	biological hazard	No			No
	chemical hazard	Yes	harmful substances and heavy metals absorption from the air and water during navel orange growing	test the soil, air and water, make sure all of them line with national standards	Yes
	physical hazard	No			No
Sapling selection	biological hazard	No			No
	chemical hazard	No			No
	physical hazard	No			No
Planting	biological hazard	No			No
	chemical hazard	No			No
	physical hazard	No			No
Navel orange tree management	biological hazard	No			No
	chemical hazard	Yes	Use growth regulator	limited	No
	physical hazard	No			No
Soil management	biological hazard	No			No
	chemical hazard	Yes	Use steamed soil fumigant	limited	No
	physical hazard	No			No
Irrigation management	biological hazard	No			No
	chemical hazard	Yes	Irrigation water contain harmful substances, heavy metals	make sure water line with national standards	No
	physical hazard	No			No
Fertilize	biological	No	fertilizer storage	separate the fertilizer and	No

management	hazard			fruit	
	chemical hazard	Yes	Fertilizer contain harmful substances, chemical and heavy metals	Handle the organic fertilizer before use	No
	physical hazard	No			No
Flower management	biological hazard	No			No
	chemical hazard	Yes	Use fruit growth regulator	limited	No
	physical hazard	No			No
Pest control	biological hazard	Yes	Use biological pesticide	line with national standards	No
	chemical hazard	Yes	Use chemical pesticide	line with national standards	Yes
	physical hazard	No			No
Harvest	biological hazard	No			No
	chemical hazard	Yes			No
	physical hazard	No			No
Washing、waxing、grading、packing	biological hazard	No			No
	chemical hazard	Yes	Use disinfectant and wax	make sure all of them line with national standards	Yes
	physical hazard	No			No
Storage	biological hazard	Yes	Fruit rot during the storage	Control the storage condition	No
	chemical hazard	Yes	Use chemical anti-stalling agents	limited	No
	physical hazard	No			No
Transportation	biological hazard	Yes	Generate pathogens during transportation	control transportation condition	No
	chemical hazard	No			No
	physical hazard	No			No
Sale	biological hazard	Yes	Generate pathogens during sale	temperature control	No
	chemical hazard	No			No
	physical hazard	No			No

4 Determination of Navel orange traceability information

In order to track and trace the safety information of navel orange, the traceability information of the whole process from orchard to market should be identified and recorded [7,8]. Generally, there are four main steps information should be acquisitioned and recorded: origin information of the orchard, planting process information, production process information and storage and transportation information.

When an orchard was selected, we should investigate land use history, soil type, soil erosion and ground water quality. Evaluate whether the regional air, soil, irrigation water and other conditions, such as soil heavy metal, suit for navel orange growing. Others information like the place of orchard, the owner of the orchard, the varieties of navel oranges should be known.

In the planting process stage, different measures should be taken to deal with different diseases, pests. So the diseases, pests information and the information about the amount, time of chemical fertilizer, pesticide must be recorded.

During the production process, the information about the enterprise which packing the fruit, the disinfectant and wax during the washing, waxing must be tracked. In the final step before sale, we shall figure out where the navel orange storage, how the condition about the warehouse. The information about the transportation also should be recorded.

The traceability code is the unique identification of navel orange in sales link. All of the quality and safety information of the product can be obtained through this code, combined with the navel orange traceability system.

Table 2. Traceability information of navel orange

Production process	Traceability Information
Origin	regional air quality(SO2、fluoride)
	irrigation water quality(heavy metal pollution)
	navel oranges varieties、 place、owner
Planting process	diseases, pests information
	amount, time of chemical fertilizer use
	amount, time of pesticide use
	extreme climate、employee information
Production process	disinfectant quality safety information
	wax quality safety information
	enterprise、 employee information
Storage and transportation	storage surroundings information(temperature、moisture、sanitary conditions)
	transportation information(temperature、moisture、sanitary conditions)
	enterprise and employee of transportation
Sale	supermarket or terminal market
	traceability code of navel orange

There are many links that make navel orange infected bacteria from orchard to sale, but these hazards can generally be controlled by SSOP (Sanitation Standard Operating Procedure).

5. Conclusion

This paper discusses what the traceability system should trace; and which information should be recorded for implementation of the traceability system of navel orange. Three main hazards of navel orange are pointed out in the paper; those may harm consumers' health. Based on analyses the whole process from orchard selection to navel orange sale, as well as safety factor of navel orange, five critical control points of navel orange are determined with HACCP method. These critical control points are the focus of the traceability system; and they should be recorded precisely

during the entire process. In the end of this article, the traceability information is determinate basic on the critical control points. This study makes the navel orange traceability system construction possible.

Acknowledgments. This study is supported by The National Science and Technology Support Programme (2009BADC4B04).

References

1.Liu Yin, Chen Licheng. Traceability Production System of Beef in EU and USA, food science, 2003(8)，182-185
2.Pu Yinyan. Construction of traceability system for quality safety of apple and apple juice, Transactions of the Chinese society of agricultural engineering, 2008，24(2)，289-292
3.Fan Hongping，Feng Zhongze，Yang Ling，Ren Aisheng. Appliance and Discussion of Traceability System in Food Chain. Ecological Economy. 2007, 17(4): 30-33
4.Bao Dayue. Guide to implementation of HACCP, Chemical Industry press，2007
5.Xu Jin. Agricultural product supply chain---Guarantee food safety. China Logistics & Purchasing，2005(07)
6.Yu Hui，An Yufa. Theoretical discussion of implementation Traceability System in food supply chain. Agricultural Quality and Standards，2005(03)
7.Zhang Gumin，Chen Gongyu. Food safety and Traceability System. China Logistics & Purchasing，2005(14)
8.Zhou Yingheng, Geng Xianhui. Application of Traceability in Food Safety. Research of Agricultural Modernization, 2002(06)