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# The Study on Navel Orange Traceability Chain

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**Abstract:** Navel orange is one of the characteristic agricultural products in the middle region of china. The traceability system for navel orange can enhance consumer confidence due to the “stained navel orange” incident. Research on the navel orange traceability chain 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 planting, harvesting, processing, packing, transportation and sale, the critical control link and the critical control point of navel orange traceability chain were fixed combined with the actual situation in china. Further, the code of the navel orange traceability is designed based on EAN.UCC system, which includes origin, processing and the end product. This study makes it possible to construct navel orange traceability system.

**Keywords:** navel orange; critical control point; HACCP; traceability chain; encode

## 1 Introduction

Navel orange is one of characteristic agricultural products in the middle of china, which is demanding climate for growing. The origin of the navel oranges mainly distributed in south Jiangxi province, zigui, Hubei province, fengjie, Chongqing province, binzhou, Yunnan province.

Gannan is located in the sub-tropical southern margin of the South. The climate of gannan is a typical sub-tropical moist climate, the soil of gannan contains many kinds of trace elements for fruit tree and navel orange, both of them suit navel oranges grow.

Gannan is the advantageous product area of 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”. The navel orange produced in gannan has many unique features, such as large shaped, bright color, crisp flesh and taste good. Navel orange industry is an important pillar industry in Gannan region, which is one of nine advantages of agricultural products selected by ministry of agriculture in china. Many counties have taken navel orange as an important tool for local farmer income.

However, the incidents occurred in recently years, such as “dyeing navel orange” in Hong Kong in 2004, “bactrocera minax” in guangyuan city, Sichuan province, have damaged the orange industry in south of china. 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.

Generally, from tree planting to bear fruit need 2-3 years for navel orange tree, from blooming to outcome need 280-300 days for navel orange. There are a lot of links and elements affect the quality safety for navel orange. In order to standardize the navel oranges grow and process, “Technological regulation of navel orange cultivation in south Jiangxi, south Hunan, and north Guangxi” has been developed to standardize the whole process from tree planting to fruit picking of navel orange.

In order to guarantee the quality safety of navel orange, we should monitor the whole process from tree planting to fruit processing[1], which also called “management from orchard to table”. Currently, traceability systems for agricultural products are established gradually to ensure the quality safety[2,3]. 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], and encode the traceability chain of navel orange with EAN.UCC system, both of them are precondition of traceability system construction.

## **2 Main hazard of navel orange**

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 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 Navel orange critical control point analysis**

### **3.1. Navel orange production process analysis**

Generally, there are 11 steps from navel orange tree planting to navel orange fruit sold 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] (shown as Fig. 1).

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 suit for navel orange growing. During the soil fertilizer and water management period, we should determine the rate, time and method of irrigation and fertilizing. In the insect control stage, different measures should be taken to deal with different diseases, pests.

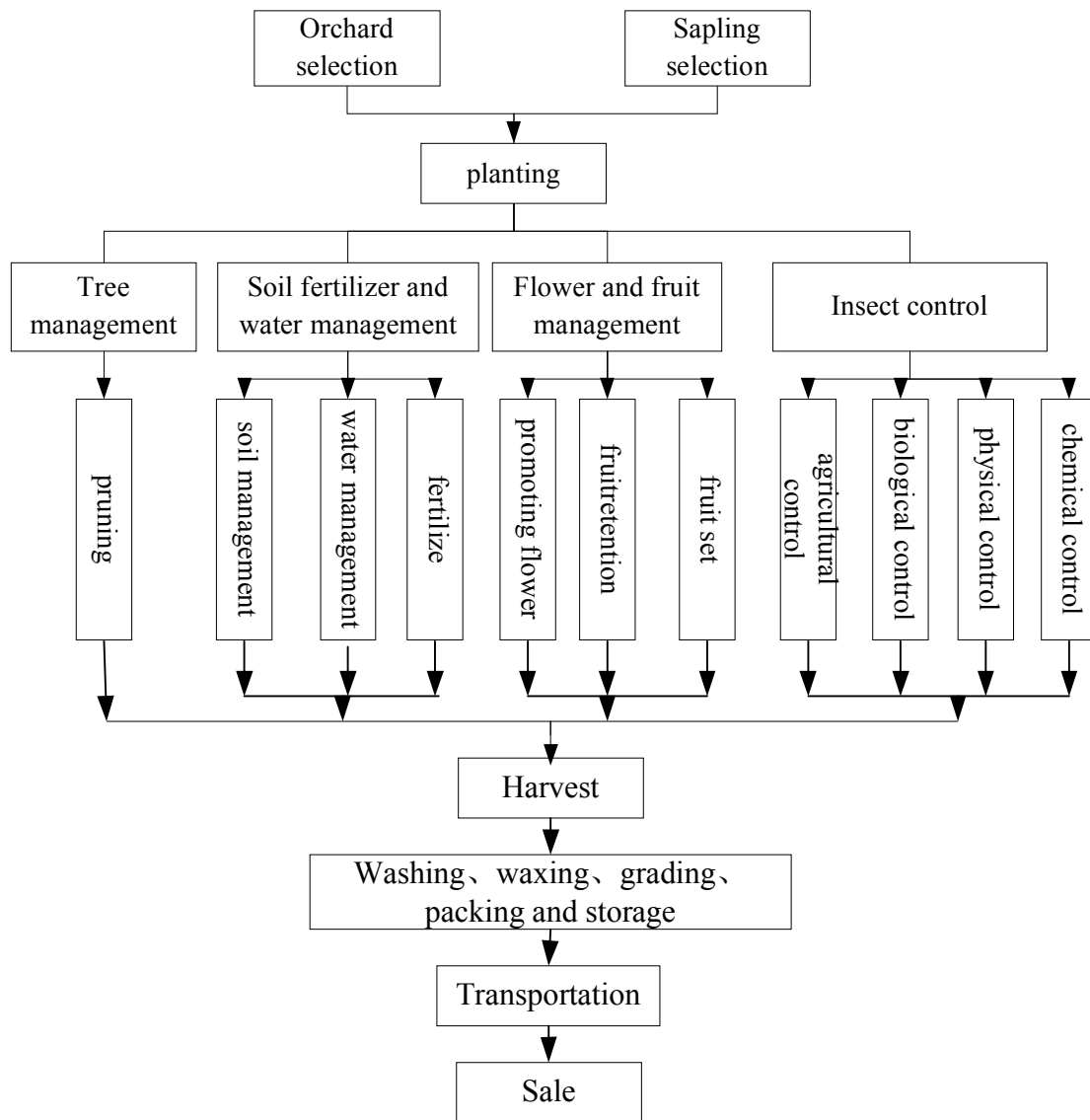


Fig. 1. 11 steps of navel orange growing

### 3.2. Navel orange safety factor 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].

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). So the biological hazards in navel orange significant hazard.

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.

### 3.3. Critical control point 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) Irrigation water.
- (3) Fertilizer selection.
- (4) Pesticides in the pest control.
- (5) Disinfectant and wax during the washing, waxing, grading and packing.

**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	Yes
	physical hazard	No			No
Fertilize management	biological hazard	Yes	fertilizer storage	separate the fertilizer and fruit	No
	chemical hazard	Yes	Fertilizer contain harmful substances, chemical and heavy metals	Handle the organic fertilizer before use	Yes
	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	No			No
	chemical hazard	No			No
	physical hazard	No			No

#### 4. Navel orange traceability code design

In order to track and trace the whole safety information of navel orange, the detail information of each step should be identified and recorded[7,8]. Unified encode system is the premise of navel orange traceability, is also the basis of information exchanging and processing. The encoding system should comply with the following principles: uniqueness, stability, commonality, expandability and applicability.

As for navel orange, we need four identification codes to indicate the quality safety information. There are origin code, enterprise code, processing batch code and traceability code. According origin code we can know the exactly place the navel orange produced, surroundings information of the orchard, and input information during the navel orange growing. Origin code is composed of 3 parts: administrative divisions' code of county, village code and unit sequence code. The code structure is shown in Fig. 2.

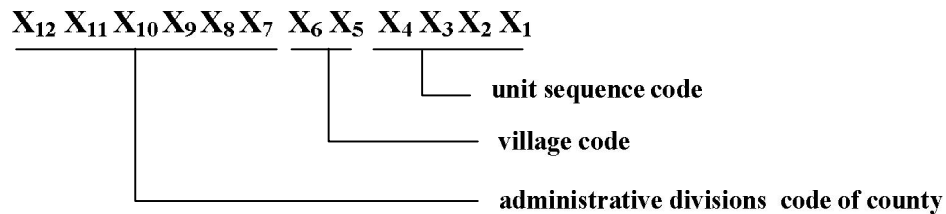


Fig. 2. The code structure of origin code for navel orange

By means of enterprise code, which refer the existing enterprise code, we can know where the navel orange washing, waxing, grading and packing.

The information about the disinfectant and wax can be obtained by means of processing batch code, which has two parts, processing date and sequence code. Processing batch code structure is shown in Fig. 3.

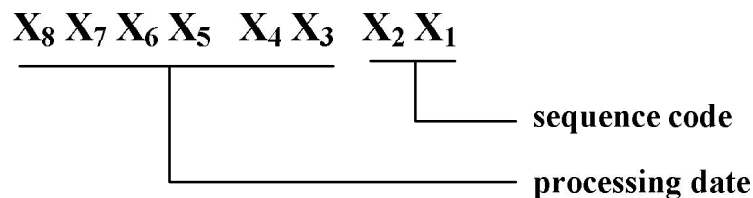


Fig. 3. The code structure of processing batch

The traceability code is the unique identification of navel orange. All of the quality and safety information of the product can be obtained through this code, combined with the navel orange traceability system. The traceability code follows the UCC/EAN-128 standard [9], which is a worldwide standard for exchanging data between different companies. The code structure is shown in Fig.4.

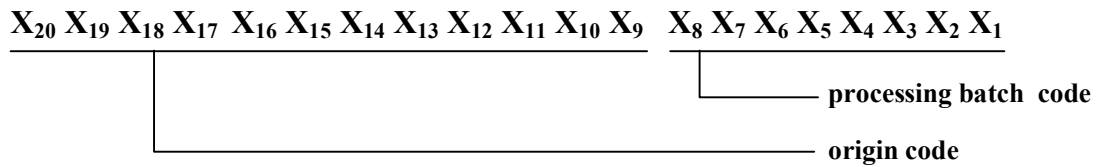


Fig. 4. The code structure of navel orange traceability

## 5. Conclusion

This paper discusses what the traceability system should trace; and which code should encode for implementation of the traceability system of navel orange in the traceability chain. 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 author designs the key code of navel orange traceability chain, which includes origin code, processing batch code and traceability code. This study makes the navel orange traceability system construction possible.

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