

Research Article

Application of Hazard Analysis and Critical Control Points in Cherry Juice Processing Enterprises

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Abstract: Qingdao is one of the homelands for Cherry in China and in recent years, deep processing industry of cherry is developing rapidly. In this study, Hazard Analysis and Critical Control Points (HACCP) quality control system is introduced into production process of cherry juice, which has effectively controlled food safety risks in food production processes. The practices have proved that application of HACCP system reduced probability of pollution in cherry juice production process effectively. The application of risk control system in cherry juice production provides benefits for standardization of the production process and helps in food safety supervision in production processes.

Keywords: Cherry juice, food safety, HACCP, production process

INTRODUCTION

Cherries have a high level of iron that is up to 59mg in each hectogram of cherries and is at the top of fruits. Both the vitamin A content and carotene content of cherries are 4 to 5 times more than those of grapes, apples and oranges. Besides, cherries also contain vitamin B, C, calcium, phosphorus and other minerals. 100g of cherries contain 83g water, 1.4g protein, 0.3g fat, 8g sugar, 14.4g carbohydrate, 66kcal heat, 0.4g crude fiber, 0.5 g ash content, 18mg calcium, 18,g phosphorus, 5.9 mg iron, 0.15 mg carotene, 0.04 mg thiamine, 0.08mg riboflavin, 0.4mg Nicole acid, 900mg ascorbic acid, 258mg potassium, 0.7mg sodium and 10.6mg magnesium. Cherries can alleviate anemia (Connolly *et al.*, 2006). Iron is the raw material for the synthesis of human hemoglobin and for women, it is of great significance. The survey of World Health Organization showed that about 50% of girls, 20% of adult women and 40% of pregnant women would suffer from iron-deficiency anemia (Lynn *et al.*, 2014). The latest study has found that cherries also contain proanthocyanidins, anthocyanins, red pigment, etc. and all these biotins have an important medical value (Righetto and Netto, 2006). Cherries' effective antioxidant has stronger anti-aging effect than vitamin E and can promote blood circulation (Peilong *et al.*, 2013), help excretion of uric acid and relieve the discomfort caused by gout and arthritis and the analgesic and anti-inflammatory effect is considered better than aspirin.

Hazard Analysis and Critical Control Points (HACCP) is a systematic preventive approach to food

safety from biological, chemical and physical hazards in production processes that can cause the finished product to be unsafe and designs measurements to reduce these risks to a safe level. In this manner, HACCP is referred as the prevention of hazards rather than finished product inspection. HACCP is believed to stem from a production process monitoring used during World War II because traditional "end of the pipe" testing on artillery shell's firing mechanisms could not be performed and a large percentage of the artillery shells made at the time were either duds or misfiring. HACCP itself was conceived in the 1960s when the US National Aeronautics and Space Administration (NASA) asked Pillsbury to design and manufacture the first foods for space flights. Since then, HACCP has been recognized internationally as a logical tool for adapting traditional inspection methods to a modern, science-based, food safety system. Based on risk-assessment, HACCP plans allow both industry and government to allocate their resources efficiently in establishing and auditing safe food production practices (Sampedro, 2014). In 1994, the organization of International HACCP Alliance was established initially for the US meat and poultry industries to assist them with implementing HACCP and now its membership has been spread over other professional/industrial areas. The HACCP system can be used at all stages of a food chain, from food production and preparation processes including packaging, distribution, etc. The Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) say that their mandatory HACCP programs for juice and meat are an effective approach to food safety and protecting public

health. Meat HACCP systems are regulated by the USDA, while seafood and juice are regulated by the FDA (Kafetzopoulos *et al.*, 2013). The use of HACCP is currently voluntary in other food industries.

Qingdao in Shandong Province, China has more than one hundred years of history of planting cherries and is known as China's home of cherries. The deep-processed products of cherries such as fruit juice and canned food have been exported to many countries and regions. Due to the large production and because cherries are perishable after being picked, the deep processing industry of cherry industrial products is developed (Huang *et al.*, 2013). In recent years, with the frequent problems of food safety, all countries also have strengthened the supervision for the safety of juice food and in order to achieve a higher quality of cherry juice, it is of great urgency to introduce HACCP to supervise the production processes of food enterprises.

MATERIALS AND METHODS

The basic principles of HACCP: HACCP is a systematic management system composed of two major parts: food Hazard Analysis (HA) and Critical Control Points (CCP). It includes seven basic principles.

Hazard Analysis (HA): Assess the risks affecting product quality and safety & health and analyze potential hazards, namely the risks of biological, chemical and physical properties from raw materials in the production process that may lead to the decline in product quality, while it is not necessary to further consider low risks or the unlikely hazards.

Determination of Critical Control Points (CCP): Identify each control point in the production process and determine Critical Control Points (CCP) according to the analyzed hazards. If control measures in this link are applied and food safety hazards can be prevented or eliminated, food hazards can be reduced to the minimum level.

Establishment of thresholds of critical control points: It refers to the process parameters or standards followed by during the control of critical points, such as pressure, temperature and other relevant parameters.

Establishment of CCP monitoring system: Monitor CCP and make accurate records, use the monitoring system for observation and measurement to determine whether a CCP can be controlled within a range and make accurate records; establish procedures and use the record results to regulate the entire production process and maintain effective control to facilitate the future verification and identification.

Establishment of corrective measures: When the monitoring system indicates that a CCP deviates from a

threshold, the correction system will take the corresponding corrective measures and establish a safe and effective preventive method to prevent the occurrence of food hazards.

Establishment of a normal and effective operating procedure of HACCP, the purpose of establishing this procedure is to regularly verify whether HACCP runs normally, including proving the rationality and validity of CCP through monitoring and whether HACCP is implemented effectively.

Improvement of a document management system: In the process of implementing HACCP, enterprises need a lot of technical documents and work monitoring records. The record content should be comprehensive and informative. In any record, "5W" content should be filled in, namely when (time), where (place), what (subject), why (reason) and who (responsible person).

RESULTS AND DISCUSSION

Application of HACCP in the production of concentrated cherry juice

Production process of concentrated cherry juice:

Receiving raw materials → cleaning → peeling and removing seeds → cleaning → color protecting → pulping → filtering → homogenizing → concentrating → sterilizing → filling and sealing → finished products

Hazard Analysis (HA) of production of concentrated cherry juice

Hazard Analysis (HA) of Critical Control Points (CCP) in the production process of concentrated cherry juice is shown in Table 1. The technological processes of non-critical control points such as cleaning of raw materials are not analyzed.

Establishment, control and corrective measures of critical control point of the production of concentrated cherry juice.

Receiving raw materials: For the raw materials that are not conducive to process concentrated juice due to various reasons (such as corruption, mildew and mechanical injury), the procurement should be in strict accordance with the national health standard or "Raw Material Procurement Standard" formulated by enterprises themselves. When replenishing the stock, inspect the relevant certificates of raw materials and make sample testing for each batch of raw materials to ensure the safety of raw materials. Reject or return the raw materials that fail to meet the requirements.

Color protecting: Soak cherry seeds into color-protection solution (such as citric acid, Vc and NaHSO₃) to prevent discoloration of the juice after pulping of cherries. The test respectively uses 0.5% citric acid, 400 ppm NaHSO₃ and 0.5% Vc as color fixative to be used alone or with compound addition. The weight of color-protection solution is 3 times of the

Table 1: Hazard analysis table of production of concentrated cherry juice

Processing procedures	Potential hazards	Reasons of hazards	Control precautions	CCP or not	Conclusions
Receiving raw materials	Pathogens, pesticide residues and pollutants of heavy metals	Raw materials with infectious bacteria, excessive spraying of pesticides and other environmental reasons	Suppliers provide written proof of product control that should be detected by special personnel.	Yes	Product quality is affected and it is hard to be eliminated by the following steps.
Color protecting, pulping, filtering, homogenizing and concentrating	Pathogens	The operation contact surface is contaminated, pathogens multiply rapidly and mechanical parts contaminate products.	Periodically clean equipment, use stainless steel equipment and finish the process in the shortest time.	Yes	Products become spoiled and it is difficult to remove metallic foreign bodies.
Sterilizing	Pathogens	Sterilization is not complete and the residual viable cells multiply.	Control sterilization conditions and repeat sterilization.	Yes	Pathogens multiply and cause spoilage, which can't be solved in the follow-up processes.
Sealing	Pathogens and contamination of container material composition	Equipment is contaminated, sealing is not tight and container wall is corrosive.	Periodically clean equipment, make operating conditions strict and select appropriate packaging containers.	Yes	Pathogens multiply and cause spoilage.

flesh and the pulping should be 15 minutes after color protection at room temperature. The test shows that if the flesh isn't handled with color protection, the seriflux will immediately become brown in the process of pulping and after the placement for a certain time, the color of the pulp will deepen. In the color fixative, no matter NaHSO₃ is used alone or with other color fixative(s), the effect of color protection is the best, but it will result that So residue in the products is difficult to be removed and will affect product quality, so it is inappropriate to use NaHSO₃. The effect of color protection of Vc can satisfy the actual requirements of production (i.e., limitation on time), but Vc is expensive, so it is generally not selected. Citric acid can achieve the effect of color protection and at the same time, it has the function of adjusting the acidity of products, so it is selected.

Pulping, filtering, homogenizing and concentrating: Strictly control pulping conditions to make both the stone and the flesh can be fully separated without stone rupture to cause discoloration and off-odor of cherry juice. Cherry juice has heat sensitive and when it is concentrated at high temperature, it is easy to have adverse changes, so vacuum concentration should be adopted. The concentration temperature is between 25 and 35 degree centigrade and the vacuum degree is 710-750 mmHg. In this process, the enterprises should regularly clean and repair equipment to prevent microorganisms from growing and foreign bodies and debris from entering into juice; use stainless equipment to prevent discoloration and off-odor and the influence on product quality.

Sterilizing: Input cherry juice into Pasteurizer flash sterilizer for sterilization and control the sterilization temperature between 85 and 92 degree centigrade and the sterilization time between 30 and 50 sec.

Filling and sealing: Concentrated juice should be filled immediately and before filling, containers should be cleaned and sterilized to meet the health requirements. Aseptic filling can be used if it is conditional.

HACCP monitoring records: Implement HACCP in the production of concentrated cherry juice (Macheka *et al.*, 2013) and the monitoring records mainly include the following aspects:

- Inspection records of raw materials of cherries
- Environmental health records of employees and workshops
- Records of pulping, filtering, homogenizing and concentrating
- Sterilizing records
- Filling and sealing records
- Equipment maintenance records
- Audit records.

CONCLUSION

By analyzing and studying the technological process of concentrated cherry juice products, this study has determined 5 critical control points. Through the control of the critical control points in the production process, the quality of concentrated cherry juice can be effectively controlled, substandard products can be avoided and the safety of concentrated cherry juice can be improved.

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