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Application of Haccp System in the Manufacture of Halawa Tahinia from Sesame

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Abstract.

In this study the HACCP system was applied on of halawa tahinia production from sesame in El-Rashidi Confectionery Factories Development Company (El-asly). The system was in terms of the Codex, where the HACCP team was formed a flow map for the industry was developed, and through a decision making tree, points were identified critical control ponts(CCP) of the stages of the industry that go through the following steps (receipt to packaginy).The critical points were as follows (the stage of roasting sesame , the stage of softening the tahini , the vacuum stage and the metal detector stage). The risks were identified at each point and it was the most important chemical hazards such as (pesticide residues and heavy metals) as well as microbiological risks such as total aerobic bacterial count, *yeasts* and *molds*, *E.coli*, *Bacillus*, *Salmonella* and *Clostridium*. The results estimated of pesticide residues were >0.01 mg/kg, heavy metals (lead 0.05 mg/kg, arsenic negative.and copper0.088 mg/kg) and the results of microbiological *salmonella* were negative *E. coli* >10 cells/gm and *Staphylococcus aureus* >10 cells/gm. The data demonstrated that applying HACCP system will improve the quality of the final product halawa tahinia.

Key words: Halawa tahinina, HACCP, microbiological hazard ,chemical hazard, sesame**.**

Introduction

The HACCP defined as system that identifies, evaluates and controls of hazards which are significant for food safety **(Mortimore, 2001).** HACCP was first designed by the Pillsbury Company, together with NASA and the US Army Laboratories at Natick (**Motarjemi, 2013**). They developed the HACCP system ensure the safety of food for astronauts. For many years after its adoption by NASA, the system was accepted international organizations such the World Health Organization and was applied on a voluntary basis in certain food industries (**Motarjemi *et al.*, 1996**). In 1993, the Codex Alimentarius Commission embraced the HACCP system a powerful tool to improve food safety and established the Codex guidelines for the Application of the HACCP system. This had major implications on the widespread implementation of the HACCP system. In 1995, with the establishment of the World Trade Organization (WTO) and the coming into force of the Agreement on Sanitary and Phytosanitary Measures, the work of Codex guidelines and recommendations became the international reference for national requirements in food safety **(Mortimore and Wallace, 2013)**. This meant the application of the HACCP system became an international requirement for food safety assurance. Currently, the principles of HACCP are found in the national legislation of many countries, (**ISO, 2005**).

Food safety is importance that concern in Egypt and world The World Health Organization (WHO), recognizing that unsafe food has great health and economic consequences from its inception promoted food safety. The conventional approach ensuring food quality and safety, which depends on inspection and testing of end products, has proved to be inadequate in controlling food-borne disease outbreaks. This may be particularly so in the case of traditional foods, because of their diversity and the great number of personnel involved in their production. food safety, is logical, practical and preventive in nature, and may be implemented at all stages of the food production process, (**Codex Alimentarius Commission, 2003**).

The use of HACCP by food establishments as a methodology to assure the safety of food is increasing worldwide. Although the fundamentals of HACCP have been constant, the application of HACCP continues to be refined to meet the challenges of a dynamic food system. These changes can be seen in the impact on government regulations affecting the industry **Orriss and Whitehead (2000).** Establishments must then work with the government agencies to define how these regulatory actions will impact their operations and refine what they do in order to comply, **(Garcia, 2009)**.

Sesame (*Sesamum indicum L.*) family Pedaliaceae, is one of the most ancient oilseeds crop known to mankind. It is extensively grown around the world in the zone extending from 35 N to 25 S latitude. India, Sudan, China and Burma are considered as the major producers (60% of the total world production). Sudan ranks third **Abou-Gharbia *et al*. (2000)** in terms of world production and first in terms of world export. The commonly cultivated varieties in Sudan are white and brown seeds sesame. The importance of sesame as source of edible oil and high quality protein is continuously increasing. Sesame plays an important role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes **(Elleuch *et al*., 2007)**.

Halawa tahinia (also called halawa, halaweh, havah) is one of the oldest traditional desserts and is popular confectionery products in Middle Eastern, Indian and North African countries and is available in different forms and flavors. It is a traditional food consumed generally at breakfast

Kahraman *et al*. (2010) halawa spread worldwide, being produced with a wide variety of ingredients, methods and flavorings. In the Middle East, semolina-based halawa is the usual type and is modified by the addition of nuts, dried fruits, coconut, yoghurt, honey and spices **Davidson. (2006)** It's a greasy product due to high share of tahini paste which contains more than 50% sesame oil **Sanja *et al*. (2015)** tahini (tehinah, tehena, tehineh), the basic ingredient of halawa tahinia, is mainly composed of 57-65% oil, 23-27% protein and some minerals **Yamani *et al*. (2006)** and **Martinchik (2011)** and **Abu-Jdayil *et al.* (2002) Batu *et al*. (2009)** halawa tahinia, it is a good source of inorganic components. About 100 g of halawa tahinia meets 58% of Fe, 55% of Mg, 48% of phosphorus, 36% of zinc, 18% of Mn, and 5% of Ca for human daily requirements of an adult. In addition, 100 g halva contains 29.6 g fat, 22.8 g protein, 43.5 g total sugar, 1.54 g ash, and 0.89 g crude fiber and provides 540 kcal. Energy **(Güler, 2003)** halawa tahinia has low water content, therefore, it has about 1 year of shelf life. Traditionally, halva is formed by mixing previously prepared sesame oil (120–130 °C) and the mixture of soapwort extract taken into kneading vessels and shoveling until the desired consistency is met. In these procedures, boiling times and temperature, flapping shapes, and cooling processes are vital elements **(Hizaroglu, 2013**)halwa which reaches the normal consistency is wrenched in pieces and pressed by placing on the tray. halawa trays are transferred to the rooms and waited for approximately 18–24 hr for cooling. After cooling, halva is cut out of the tray and classified according to the desired cutting size and is aligned with the packaging machines by hand, halva is cut, and packaged. Traditional halva, which is a solid at room temperature. A new product of halawa has appeared on the market recently, and it is in the form a paste. This form of paste facilitates the use of halawa in many forms of diets, such as sandwiches, and does not contain an extract that contains soap several studies have been conducted on the chemical and nutritional properties of tahini, and the sweetness of tahini. Recently, there been a noticeable has increase in investigations into the flow properties of tahini and mixtures containing tahini **(Juri *et al.*, 1991).** Halawa tahinia has a long shelf life (approximately two years from the production date) because of its low moisture content (3%). Depending on temperature and humidity conditions, changes during production, storage, distribution and usage, condensation problems may occur and this cause the growth of microorganisms (**Sengun *et al*., 2005).** Furthermore, mishandling and poor production processes may also affect the hygienic and chemical quality of halva. Several studies regarding the microbiological and chemical properties of halva were carried out by **Eissa and Zohair (2006).** Driven by increasing awareness and preference of consumers healthy products the market expanding with the use of high technology in processing and packaging **(Dilek *et al.*, 2016).**

This study aimed to apply the HACCP system on halawa tahinia production line and estimated CCPs

Materials and Methods

2.1. Materials:

The raw samsem seeds used in the manufacture were obtained from Shalateen (Sudan) and salt was purchased from Al-Safwa (Al-Arish), sugar was purchased from Nile Sugar Company Giza Governorate, Egypt. Citric acid and vanillin from Donny Pack Company in Port Said, Egypt. Demodan HB was purchased from Danisco in Denemark. Saponin was purchased from the Egyptian Turkish company Egypt. Lecithin (E232) from Alexandria Seed Company, Egypt Glucose from the Ezmerada Company in Egypt. These materials were shipped in suitable transport containers and good storage.

2.1.1.Culture media:

All medium for microbiological examination were obtained from Oxoid Limited Co, Hampshhire,England and Biolife Limited Co., Italiy

2.2.Methods:

2.2.1.Technological methods:

All products manufactured at Elrashidi Elmizan Company (EL-asly) in 6th October City , Giza, Egypt.

2.2.2. Tahina processing:

The presented sesame seeds have been prepared, sieved and cleaned of any foreign matter mixed with them. The seeds were immersed in water inside a 3500 kg container of seeds for 3 horus and peeled for 5 min. the husks were removed by preparing brine with a concentration of 20:18% salt and then performing brine removal using fresh water for several times, then transferred to roasting ovens 3 horus 95:105°C then aeration process, then grinding the seeds and Obtaining The ready-made tahini product and working on the halva production line, Turkish industry model (33203- Turkey) **(Var *et al.*, 2007)**.

2.2.3. Manufacture of Halwa tahania:

Tabel (A): Ingredients of halawa

Ingredients	(%)
Sesame puree	43.3
Sugar	43.3
Lecthin	1.08
Glucose	10.8
Citric acid	0.0016
Vanillin	0.0016
Water	26.6
Dimodan HP	1.08
Salt	0.13

Part (1): The sugar was mixed with citric acid, then adding it to water at 90˚C and blending 20 min, then adding all salt to the mixture.

Part (2): The mixture is sent to the cooking stage, where the cook heats the sugar solution at a temperature of 130 to 140˚C until it is settled, then it is sent to a dual-air tank to remove the latent heat and to the vacuum phase at 120:125˚C(3:4 minutes). the cooking product is sent to the bowl of the kneading machine, kneading and adding the rest of the additives. the packages are packed and closed with plastic covers, and then the product is sent to the ventilation tunnel and then packed in cartons to print the production date and its validity on the carton and the stickers affixed to the packages. the product was stored in the complete production warehouse processing machinery **(**model 502-Cairo Eygpt) **(Batu *et al*., 2009)** processing line were conducted in accordance with **(ISO22000, 2018**).

2.2.4. Application of HACCP system:

Horchner *et al.* (2006) recommended these steps to apply the HACCP system. The term ‘‘HACCP plan’’ implies the **Codex HACCP** methodology **(Codex Alimentarius Commission, 2003**).

2.2.4.1. Microbiological examination:

Ten mL of each sample was added to 90 mL of sterilized peptone water (1 g/liter) and the mixture was blended for 30 sec give 1:10 dilution further serial dilution also made appropriate dilutions in the following determination:

The dilution was examined for total viable bacterial count and *yeasts* and *molds count* according To **ISO 4833-1 (2013).**

2.2.4.1.1. Total aerobic bacterial count:

Two duplicate sets of Petri- dishes, add 1 mL aliquots from 10^{-1} to 10^{-6} dilutions by pipette in standard plate count agar (**PCA, oxoid code: CM0463)** and melted in following steam. The agar cold to 44-46°C then poured into Petri- dishes. Immediately, aliquots were mixed with the agar medium by tilting and rotating the Petri- dishes. After solidification, the Petri- dishes were inverted and incubated at 37˚C for 48 hours. The growing aerobic colonies were counted and multiplied by the dilution **ISO 4833-1 (2013).**

2.2.4.1.*2.Yeasts & molds* count:

The *yeasts* and *molds* were determined using the methods for the microbial examination foods as described by **ISO 21527-2 (2008)** using Rose Bengol Chloramphencicol Agar (Biolofe, cod, **No. 4019912**) and chloramphenicol antimicrobial supplement cod, **NO. 421840003)**, incubation at 20-25 °C for 5 days.

2.2.4.1.3.Coliform bacteria count:

Incubation was carried out 37°C for 48 hrs. The counts were then calculated per gram of samples as reported by the methodology of **ISO 21528-2 (2004).**

2.2.4.1.4.*Escherichia* coli count:

The presence or absence of *Escherichia coli* was detected according to the methods described by **ISO 16649- 2 (2001).**

2.4.1.5.*Bacillus* cereus count:

Bacillus cereus was determined using the methods for the microbial examination of foods as described by **ISO 7932 (2004)** using mannitol egg yolk polymyxin agar and *Bacillus cereus* selective supplement, suspend 21.5 g in 450 mL distilled water and bring gently to the boil to dissolve. Sterilise by autoclaving at 121°C for 15 min. Cool to approximately 49°C and aseptically add 50 mL egg yolk emulsion (SR0047) and 1 vial of *Bacillus cereus* selective supplement, reconstituted as directed. Mix well and pour into sterile Petri dishes.

2.2.4.1.6.*Staphylococcus aureus* count:

The Staph. aureus bacteria was determined according to the method described by **ISO 6888-1 (1999; 2003)** using baird- parker medium plus 5 ml egg yolk tellurite emulsion to each 100 mL of sterilize media which mixed well before pouring in the plates. The plates were incubated at 37°C for 24 hr.

2.2.4.1.7.Detection of *Clostridium sp.*

This method is based on the detection of typical gram positive *Bacilli* with subterminal oval spores grow on samples medium and producing turbidity, gas production and digestion of the samples particles by

ISO 7937 (2004). Place about 5 mls of homogenized samples into each of three tubes. Heat one of the tubes to 60˚C for 15 mins. and another to 80°C for 30 mins. in water bottles. Leave the third tube unheated. Incubate all tubes at 30˚C for 5-15 days and examine for turbidity, gas production and digestion of samples particles. After 5 days examine cultures for turbidity, gas production, digestion of samples particles and odor. Also examine microscopically a smear stained by gram stain. Observed morphology of organisms and note existence of typical clostridial cells, occurrence and relative extent of sporulation and location of spores within cells. If there is no growth after 5 days, incubate and examine again after 10 days.

2.2.4.1.8.Detection of *Salmonella sp.*

The presence or absence of *salmonella* was detected according to the method described by **ISO 6579-1 (2017)** as follows:

(1) Pre- enrichment: 25g of representative sample were mixed with 225 ml buffered peptone in a sterile 50 mL bottle and incubated at 37˚C for 16-20 hr.

(2) Selective-enrichment broth: l mL from each pre-enrichment bottle was transferred to

10 mL Muller-Kauffmann Tetrathionate Novobiocin Broth (MKTT-n) and incubated at 37°C for 24 hours.

(3) Selective plating medium**:** A loopful from the enrichment broth was streaked into Xylose-Lysine-Desoxycholate Agar (XLD medium) plates and incubated at 37˚C for 24 hr. Typical colonies of *Salmonella* appeared as a black center and a lightly transparent zone of reddish color due to the color change of the indicator.

2.2.4.1.9.Swab samples from equipments, walls and worker's hands:

Swab samples were taken from equipment throughout the processing steps in halawa tehinia processing lines and from hands of plant workers by using a sterile cotton swabs by dipping in to 10 mL of 0.1% sterile peptone water, according to **Stinson and Tiwari (1978**). All swab samples were placed in an ice box and transferred to the laboratory for microbiological analysis.

2.2.4.2. Determination of heavy metals:

In sesame samples to using Perkin-Elmer, **Model 305A 2380,** atomic absorption spectrometry after wet digestion according to **A.O.A.C (2016).**

2.4.3.Pesticide Residues :

Method description: Quick and Easy Method (QuEChERS) for determination of pesticide residues in foods using GC–MS according to **ECS (2008).**

2.4.4. Chemical analysis:

Moisture, protein, fat and ash content were determined according to the methods of **(A.O.A.C., 2016).** Total carbohydrates were calculated by differences.

Results And Discussion

3.1. HACCP plan for halawa tahinia processing line:

3.1.1. Assemble the HACCP team (Step 1):

A multidisciplinary group of individuals are established to carry out HACCP studies; the team is comprised of different departments all of the HACCP team members have the training HACCP perquisites, studying and implementation. The HACCP team has technical knowledge of the process covered by the HACCP study, knowledge of hazards associated with malting and experience within the scope to hazard analysis, developing HACCP plans, implementing and reviewing HACCP. The team (team leader, deputy team leader and members) as well as the supporting functions have been officially assigned by the plant manager, and the team organization has been communicated through the plant of department and section heads. Training Records for the HACCP team should be available.

These results are in agreement with the obtained results by **Varzakas (2016).** Team members away from their job responsibilities have the responsibilities of product description developing, updating the HACCP study determining CCPs /PRP with their critical limits monitoring procedures and corrective action, verifying the flow charts and notify the rest of the team and meet on discuss/review the previously mentioned issues; this meetings are conducted as minimum once per quarter and whenever needed in case of any issue threatening the food safety of the product and/at after any process changes to decide whether it will affect food safety or not.

The HACCP team leader lead and direct the HACCP team meeting to conduct the hazard analysis, follow up the results of monitoring, review internal audit, HACCP Complaints and any food safety related issues.

The core HACCP team includes Quality Assu rance manager Productionmanager, Engineering manager, QC section head, Microbiologist, Warehouse Keeper and HACCP Consultant (Expert).

3.1.2. Product description (Steps 2) and Identify intended use (Step 3):

Ingredients100% pure Sesame - Sugar - Glucose - Vanillin - Citric acid - Lecithin Salt food additives Description: Halawa is prepared from pure sesame Free of any additives storage and Distribution in a cool dry place, keep in a cool place temperature (+25°C); away from moisture and direct sunlight; Consume as soon as the package is opened or stored in the refrigerator; Free from preservatives or artificial colours Shelf life 12 months from the date of production Cool intended for manufacturing only Customers The general public (preferably more than 3 years old), and not to be consumed by risk groups (diabetics and allergy patients).

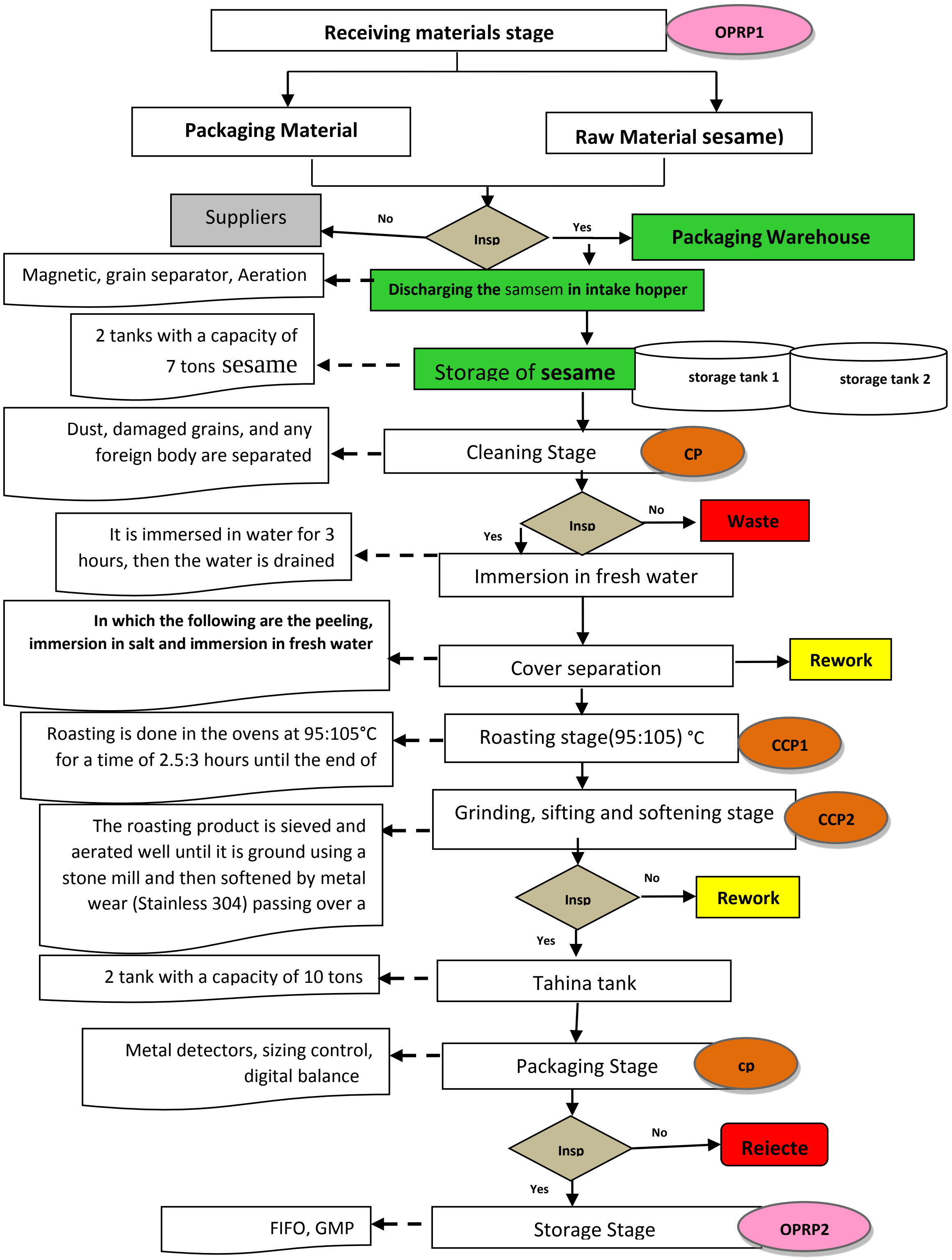

Fig. (1): Flow chart of tahina milling process (Codex Standard, 2003):

The results are in agreement with these obtained results by (**Birer, 1985 and Varzakas, 2016 and Xiaowei *et al.,* 2016),** they reported halawa is one of the most nutritional food products.

3.1.3. Construct flow diagram (Steps 4) and On-site verification of flow diagram (Step 5):

The process flow diagram provided is a detailed description of the process to help the HACCP team carry out the hazard analysis. The process flow diagram of halawa tahinia prepared and assured that, it cover all process steps of product from first step to final product, including re-work routes. The HACCP team has confirmed that the on-site process steps match the diagrams in plant tahina processing line flow diagram **Fig. (1).**

3.1.4. Principle 1: Conduct a hazard analysis (Step 6)**:**

Hazards analysis for tahina processing steps was conducted. The potential hazards (physical, chemical and biological) associated with halawa) production at all steps, and the preventive measures for their control were identified.

3.1.4.1.Physical hazards:

The physical hazards associated with raw sesame were identified and the obtained results were as follow: unripe seeds: 4%, poretin content 20%, shrivelled seedes 0.01, pest damage: 1.50%, not decorticated sesame5%, insects fragments represent: 0.%, sand%: 0.20% oil content 47:50%, critical harmful foreign bodies (physical hazards): zero these results are within limits the specification (internal standard) standard specification **NO1764/2006.** The results are in agreement with these obtained results by **El-Khier *et al*. (2008)**.

3.1.4.2. Chemical Hazards:

Raw sesame was mainly examined for pesticides residues and five heavy metals (Arsenic, Lead,).

3.1.4.2.1.Pesticide residues:

The pesticides are dangerous and toxic to human health, any pesticide residues remaining in tahina and halawa can pose hazard to humans and cause confident diseases. It is important to classify and measures the pesticide residues which can be swallowed by raw sesame after treatment with pesticides spray.

A final product were analyzed for chlorfenapyr, fludioxonil, cypermethrin, lambda-Cyhalothrin, chlorpyrifos-Methyl and pyridaben pesticide residues are followed during the processing steps of halawa on . The obtained results are hereafter showing in **Table (1)** revealed that pesticide residues contents were lower than those presented in **ES (2020)** for the maximum limits of pesticide residues in foods and the EU MRLs **(EC, 2005**).

Table 1. Assesssment of pesticide residues in sesameand sugar (mg/kg).

Components	Sesame raw			sugar		
	*S. 1	S. 2	S. 3	S. 1	S. 2	S. 3
Chlorfenapyr	**0.010**	**-**	**-**	**0.010**	**-**	**-**
Fludioxonil	**0.010**	**-**	**-**	**< LOQ**	**-**	**-**
Cypermethrin	**0.010**	**< LOQ**	**0.010**	**0.010**	**< LOQ**	**0.010**
Lambda-Cyhalothrin	**-**	**-**	**0.010**	**-**	**-**	**< LOQ**
Chlorpyrifos-Methyl	**-**	**-**	**< LOQ**	**-**	**-**	**< LOQ**
Pyridaben	**-**	**< LOQ**	**-**	**-**	**< LOQ**	**-**

ND: Not detected - < LOQ: Limit of quantitation * S.: Sample no.

1.4.2.2.Heavy metals:

The sesame were analyzed for lead and copper and arsenic heavy metals are followed during the processing steps of halawa. The obtained results are hereafter showing in **Table (2)** revealed that heavy metals contents were not detected than those presented in **ES (2005)** for the maximum limits of heavy metals in foods The results are in agreement with the accepted limit according to **Zhu (2011).** The percentage of minerals was in agreement with his study on vegetable oils for the following elements Copper 0.035, arsenic 0.018, lead 0.011 mg/kg

Table 2. Heavy metals of raw sesame (mg/kg).

Components	CCP1**	Raw sesame***
Lead	**N/D**	**0.50**
Copper	**< LOQ**	**0.088**
Arsenic	**N/D**	**N/D**

N/D: Not Detected < LOQ: Limit of quantitation

* Each values from 3 samples at 3 different time at zero time, 4 hours and 8 hours of the production shift .

** CCP1 sesame,

*** Halawa tahinia: as a finished product.

3.1.4.3. Biological Hazards:

Biological hazards were evaluated microbiologically of raw for total aerobic bacterial count, *yeasts* and *molds*, *coliform* group, *E. coli*, *Staphylococcus aureus, Bacillus cereus, Clostridium sp*., and *Salmonella sp*. as well as through every processing steps along the processing line of Halawa tahinia to identify the biological hazards that might associate with the final Products and the results are shown in **Table (3)**.The results showed that the products were free of any pathogen contaminants. Bacteria *(E. Coli, Staphylococcus aureus, Clostridia sp., Bacillus cereus and Salmonella sp.*), with pathogenic bacteria without *Salmonella sp.*. as a result of heating (at 65°C). The biological risks of production lines were also evaluated by taking swabs samples from the workers and the places surrounding the work before and after sterilization and disinfection using special sterilizers, and the results showed as shown in **Tables (4** and **5).**

3.1.5. Principle 2: Determine critical control points (CCPs) (Step 7):

Critical control points (CCPs) in the production processes on halawa tahinina were identified through the use of a CCP decision tree (**NACMCF, 1998**). **Figure (2)** and are shown in **Sheet (1).**

3.1.6. Principle 3: Establish critical limits for each CCP (Step 8):

The critical limits were the Egyptian Standa rds, Codex, and EU Standards for raw and packaging materials and final product. Whereas, the critical limits on manufacturing steps were the legal limits which admitted by the HACCP team. The established cririical limit for CCPl, CCP2, CCP3, CCP4 were established and shown in Table (3**).** including roating stage , Smoothing, grinding stage and vaccum stage, metals detector stage. To monitor system and insure that the HACCP system is working correctly.

3.1.7. Principle 4: Establish CCP monitoring requirements (Step 9):

Monitoring procedures for each CCP through tahina processing line were established as shown in **Table (3).** Monitorrng procedures included the following work sheets were developed for monitoring of each CCP processing steps on halawa tahinia.

3.1.8.
Principle 5: Establish corrective actions (Step 10):

Corrective actions to be taken when monitoring results show any deviation from the established critical limits at a CCP through halawa tahinia processing steps were developed and shown in **Table (3)** corrective action work sheet was developed for recording the non-conformities and the corrective action needed The results are in agreement with the accepted limit according to **Sengun *et al*. (2005)**.

Table 3. Microbiological examination of halawa tahina during the processing.

Components	Reference Methods	CCP1	CCP2	CCP3	CCP4	Tahina	Halawa
Total aerobic bacterial count cfu/g	**ISO 4833:2013**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**
Yeast & mould count cfu/g	**ISO 21527-2:2008**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**
Coliform group cfu/g	**ISO 21528-2:2004**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**
***E. coli* cfu/g**	**ISO 16649-2:2001**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**
***B. cereus* cfu/g**	**ISO 7932:2004**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**
***S. aureus* cfu/g**	**ISO 6888-1:1999; 2003**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**
***Clostridium count* cfu/g**	**ISO 7937:2004**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**
***Salmonella* Sp. cfu 25 g**	**ISO 6579:2002**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**	**Negative**

*Each values from 3 samples at 3 different time on zero time, 4 hours and 8 hours of the production shift .
CCP1: roasting stage, CCP2: smoothing stage CCP3: Vaccume process stage, CCP4 Metal detector stage.

Table 4. Microbiological examination of swabs taken from the hands of workers in the production line (CFU / 100cm^{2}))

Worker	Before using of hand sanitizer					After using o				
	Total aerobic bacterial count	***Stapli. aureus***	**Coliform group**	***Bacillus cereus***	**Yeasts & Molds**	**Total aerobic bacterial count**	***Staph. aureus***	**C**		
Worker bar (1)	**100**	**11**	**ND**	**3**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Worker bar (2)	**220**	**5**	**ND**	**ND**	**42**	**ND**	**ND**	**ND**	**ND**	**ND**
Worker bar (3)	**20**	**ND**	**ND**	**ND**	**12**	**ND**	**ND**	**ND**	**ND**	**ND**
Worker tahina (4)	**10**	**15**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Technician (1)	**125**	**2**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**

-cfu/hand: Colony Forming Unit/hand. - ND: Not detected

Table 5. Microbiological examination of wall swabs in the Halawa filling line (cfu/225cm ^{2}).

Wall of area	Before using of cleaning and disinfection program					After using of new cleaning and disinfection program				
	Total aerobic bacterial count	***Stapli. aureus***	**Coliform group**	***Bacillus cereus***	**Yeasts & Molds**	**Total aerobic bacterial count**	***Staph. aureus***	**Coliform group**	***Bacillus cereus***	**Yeasts & Molds**
Mixing area	**250**	**2**	**5**	**12**	**12**	**ND**	**ND**	**ND**	**ND**	**ND**
Filling area	**85**	**ND**	**5**	**8**	**17**	**ND**	**ND**	**ND**	**ND**	**ND**
Past. tunnel area	**160**	**4**	**ND**	**50**	**25**	**ND**	**ND**	**ND**	**ND**	**ND**
Labeling area	**7**	**ND**	**2**	**6**	**9**	**ND**	**ND**	**ND**	**ND**	**ND**
Packaging area	**160**	ND	**ND**	**12**	**13**	**ND**	**ND**	ND	ND	**ND**

- cfu/225cm^{2}: Colony Forming Unit/225cm^{2} - ND: Not detected

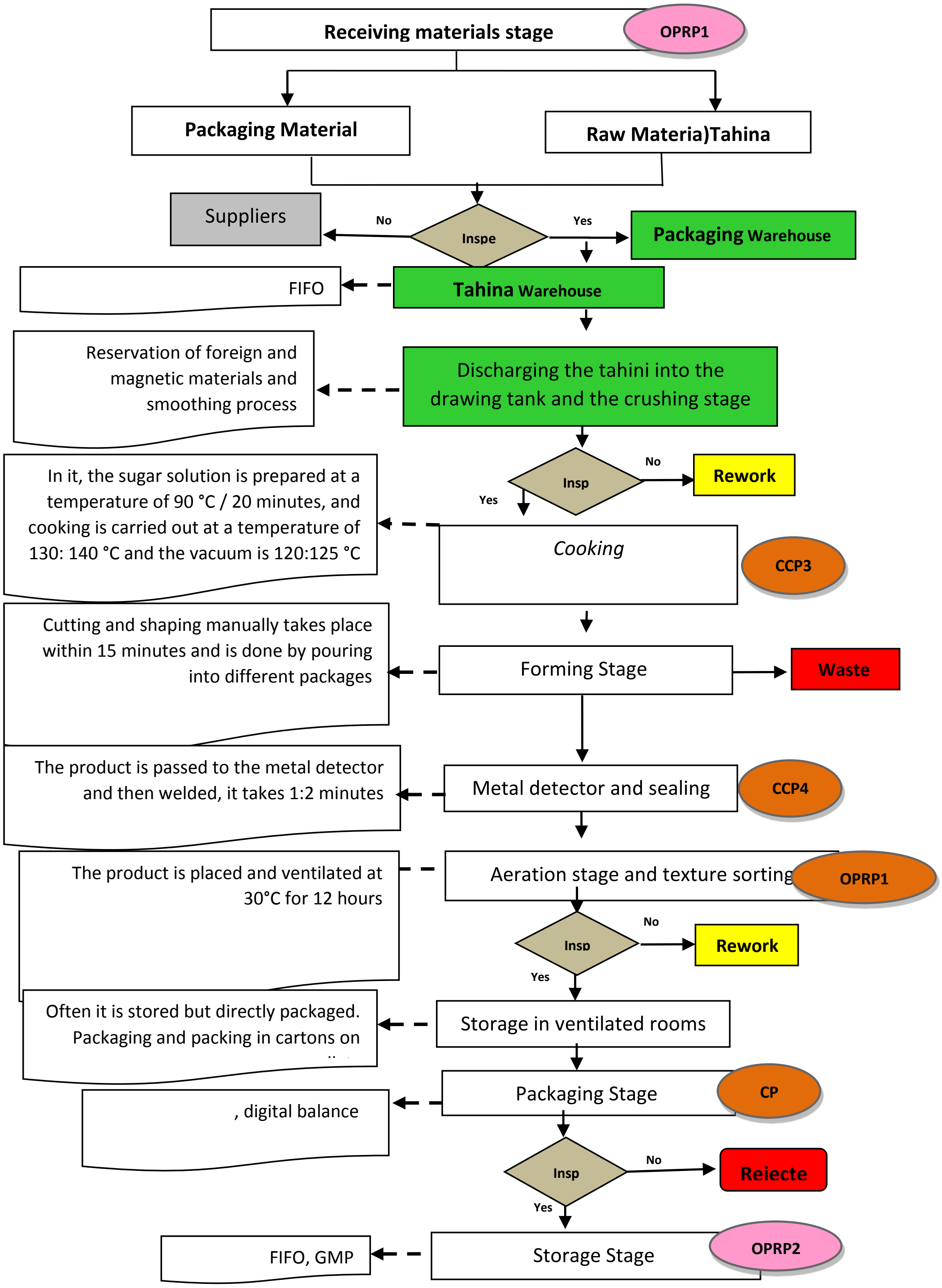

Fig. (2): Flow diagram of halawa tahinia processing line.(Codex Standard, 2003).

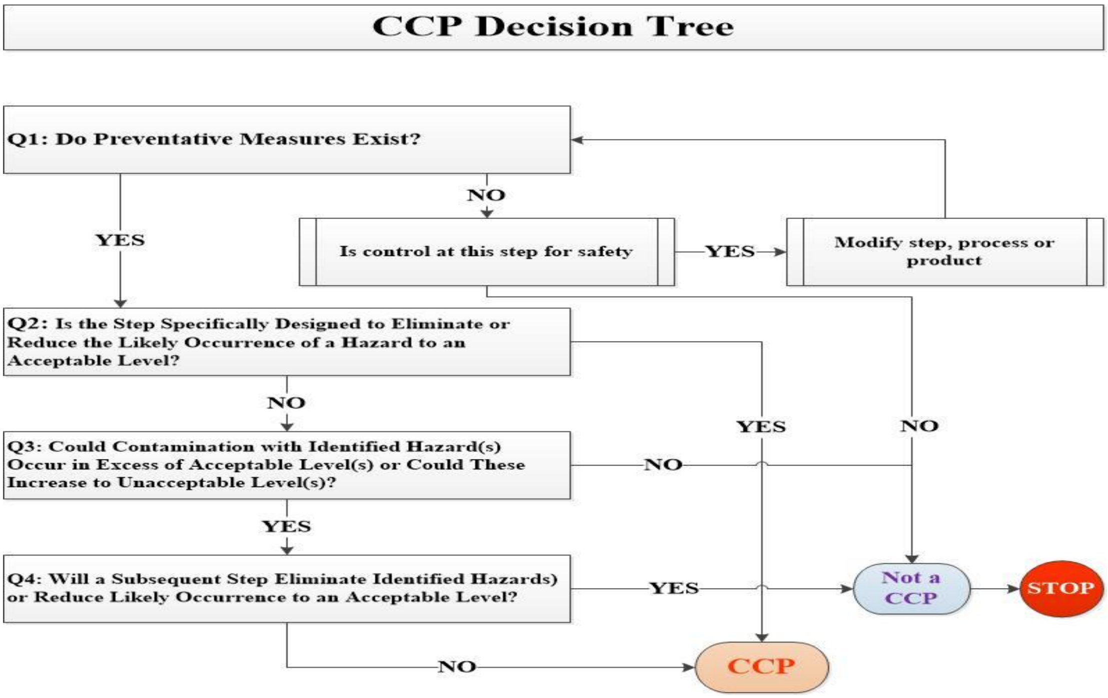

Fig. (3): Critical control points decision tree:

1.9 Principle 6: Establish verification procedures (Step 11):

Verification procedures were established ro verify that HACCP system is working correctly through halwa tahinia processing.

HACCP team is responsible for verification of HACCP system and that will achieve through:-

- Ensure that the HACCP plan of functioning effectively.
- Review of records, accuracy, on non-compliance and corrective actions taken.
- Equipment and utility checks e.g. temperature
- Audit the supplier for adherence of guarantee.
- Calibration of monitoring sensors and devices.
- Samples inspection to validation with iron Ped-dles.
- Microbiological finished product testing.
- Chemical finished products testing.

Verification procedures for each CCP were developed and shown in **Table (3).**

In our investigation from **Fig. (1)**, which presented flow diagram for manufacture on halawa tahinia with estimating the CCPs, we determined 4 critical control points, including roating stage , Smoothing , grinding stage and vaccum stage, metals detector stage. To monitor system and insure that the HACCP system is working correctly and effectively (able to finding any deviation when occur and control it) and insure that the final product in agreement with **ES (2020)** and **Codex Standard (CXS)** finally produced high safety and quality products for consumers.

1.10. Principle 7: Documentation and record keepi ng (Step 12):

Documentation and record keeping of HACCP system form halawa tahinina completed previously by:

- Listing of the HACCP team.
- Product information and its intended use.
- Flow diagram for the product.
- The entire process indicating CCPs.
- Hazards and preventive measures for each CCP.
- Critical limits for each CCP.
- Monitoring systems for every process steps and CCPs.
- Corrective actions for deviations from critical limits.
- Procedures for verification of HACCP system.
- Records keeping.

Sheet 1. Critical limits, monitoring, corrective actions, verification & records sheet of halawa tahinia

Product Name Tahinia

CCP No.	Process Step	Significant Hazards: Type	Significant Hazards: Hazard	Critical Limit for each Preventive Measure	Monitoring: What	Monitoring: How	Monitoring: Frequency	Monitoring: Who	Corrective ACtiORS	Verification	Record Keeping
CCP1	Roasting stage	Biological	Not reducing the microbial load To the permissible limits as a result Failure to implement the settlement phase properly	Settlement of sesame in its time limits from 95: 105 / 2.5: 3 hours Humidity not more than 2%	Calibration device	Temperature and roasting time to Certified Lab.	Once/ batch	By QC/QA Engineers	Heat setting Back to adjust cases of non matching QAP-08	By measuring humidity %	QAF-29-004
CCP2	Smoothing stage	Chemical	Chemical reaction as a result of contact with corrosive metal	Standard calibration	Magnet calibration	Calibration	Once/ batch	By QC/QA Engineers	Calibration	Comparing the actual temperature with the standard	QAF-29-004 QAF-28-002 QAF-28-003
CCP3	Vaccume process	Biological	Biology : didn't reach microbial load to the limit	Temp. 120:125°c humidity 1-2 %	Moisture detector instrument	Instrument temperature thermometer	Once/ batch	Quality control engineer lab engineer	NCR reports QAP-08	By measuring humidity %	QAF-29-004
CCP4	Metal detector	Physical	Presence of metal residues or pieces	According to Equipment standard	Metal detector	By using standard rode and pass it on metal detector for specific periods	3 times/ shift	Quality control engineer	Reset metal detector and pass all quantities from last check	By using standard rode and pass it on metal detector to verify metal detector working	Record in finish product inspection form

Conclusion

The system was in terms of the Codex, where the HACCP team was formed a flow map for the industry was developed, and through a decision making tree, points were identified critical control points (CCP) of the stages of the industry that go through the following steps (receipt to packaging).The critical points were as follows (the stage of roasting sesame, the stage of softening the tahini, the vacuum stage and the metal detector stage). The risks were identified at each point and it was the most important chemical hazards such as (pesticide residues and heavy metals) as well as microbiological risks such as total aerobic bacterial count, yeasts and molds, *E. coli, Bacillus, Salmonella* and *Clostridium*. The results estimated of pesticide residues were >0.01 mg/kg, heavy metals (lead 0.05 mg/kg, arsenic negative.and `copper0.088 mg/kg) and the results of microbiological salmonella were negative *E. coli* >10 cells/g and Staphylococcus aureus >10 cells/g. The data demonstrated that applying HACCP system will improve the quality of the final product halawa tahinia.

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تطبيق نظام الهاسب فى تصنيع الحلاوة الطحينيه من السمسم

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في هذه الدراسة تم تطبيق نظام الهاسب على خط انتاج الحلاوة الطحينيه من السمسم في مصانع حلويات الرشيدي الميزان (الأصلي) .حيث تم تطبيق النظام ببنودة طبقا لهيئة الكودكس حيث تم تشكيل فريق الهاسب وتم وضع خريطة التدفق للصناعة وعن طريق شجرة أتخاذ القرار وتم تحديد نقاط التحكم الحرجة لمراحل الصناعة التى تمر بالخطوات التالية (الأستلام حتى التعبئة)واظهرت النتائج ان النقاط الحرجة كالتالى (مرحلة تسويه السمسم و مرحلة تنعيم الطحينه ومرحلة الفاكيوم و مرحلة كاشف المعادن) وتم تحديد المخاطر فى كل نقطة وكانت اهم المخاطر الكيميائية حيث تم تقدير بقايا المبيدات والمعادن الثقيلة عن نقطة التحكم مرحلة التسوية السمسم والمخاطر الميكربيولوجية عند نقطة التحكم مرحلة الفاكيوم وتم تقدير العدد الكلى لبكتريا والفطريات والخمائر والبكتريا القولونية والباسلس والأستافيلوكوكس و السالمونيلا و الكولستريديم. وكانت نتائج بقايا المبيدات >0.01 ملجم /كجم ونتائج المعادن الثقيلة (الرصاص0.05 ملجم/كجم والزرنيخ سلبى والنحاس0.088ملجم/كجم) وكانت نتائج الميكربيولوجى السالمونيلا سلبى وايشرشيا كولاى > 10خليه /جم الأستافيلوكوكس >10خليه /جم . وبتطبيق هذا النظام سوف يؤدى الى تحسين جودة المنتج النهائى الحلاوة الطحينيه.

الكلمات الدالة: الحلاوة الطحينية, الهاسب , المخاطر الميكروبيولوجية , المخاطر الكيميائية , السمسم .