

## Implementation of the Hazard Analysis Critical Control Point (haccp) System for Processed Cheese Production Line.

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### ABSTRACT

Processed cheese spread was produced under two systems. The main ingredients are fresh Ras cheese .Karish cheese, palm oil, emulsifiers and (K-sorbate +Nissin) as antimicrobial substances. Results showed that HACCP system processed cheese had less total microbial count, higher chemical composition specification nearer to the standers of Egyptian Specifications. The HACCP cheese gained better evaluation scoring points for organoleptic taste judgments. Advised to follow the HACCP system for the production of processed cheese spread to have excellent healthy cheese.

Key words: HACCP, processed cheese, food safety

### INTRODUCTION

Although processed cheese was recently borne during the 20Th century, it became an important food industry over the world. It is highly appreciated among children, young and old people. Through making this type of cheese, many other cheese varieties in different ages are mixed to produce attractive processed cheese, with high and rich nutrient values. Nowadays there is an ever increasing consumer demand for safe and high quality foods of prolonged shelf life. Several quality/safety management systems (e.g., ISO 9000, Total Quality Management, and HACCP) were developed for the food industry. The hazard analysis and critical control point (HACCP) system is a preventative measure that assesses hazards, estimates risks and establishes specific control measures that emphasize prevention rather than reliance on end-product testing (A simple guide... 1993). The main potential hazards in most dairy products are microbiological (Tranter 1990), and the dairy industry has increased its efforts for quality and safety assurance through the development and implementation of proactive programmers such as HACCP(Ito 1974). HACCP was originally developed as a “zero defects” program and considered to be synonymous with food safety. HACCP is a science-based system used to ensure that food safety hazards are controlled to prevent unsafe food from reaching the consumer (Smukowski 1996, Mortimore and Wallace 1997, Morris 1997, IFST 1998, Bardic 2001). The HACCP approach is a preventive approach to microbiological quality control and is intended to prevent problems before they occur rather than finding them in the finished product. Hazard Analysis identifies the microbiological hazards and potential entry points of these hazards in the sous vide process. Critical Control Points to control the identified microbiological hazards include quality of raw ingredients, time/temperature relationship, sanitation and packaging control and incorporation of additional barriers, such as pH and water activity (wa) reduction, in the formulated product ( Smith *et al* 1990).

#### HACCP system had 7 principles:

1-Hazard Analyses Determination. This first principle 1s related to the production and estimation of hazard probabilities. 2-Critical Control Points = CCP. To be determined during production. 3-Critical Limits = CL.to put the hazard under control. 4-CCP Monitoring Requirements. Applying the correction system. 5- Corrective Actions. Explored the (CCP) which is under

Controlling. 6-Record Keeping Procedures. Establishment of recording system for the obtained results and the measurements of HACCP system. 7-Verification Procedures of HACCP System. To assure the validity of the system.

Some processed cheese manufactures traditionally made cheese without following the HACCP system either for ingredients requirement or cheese steps production. So the aim of this work is to compare between processed cheese spread produced traditionally and under HACCP system.

### MATERIALS AND METHODS

#### Ingredients used for processed cheese spread are:

Ras cheese, Karish cheeses, Skim milk powder(SMP), palm oil, emulsifiers, Water, Nissin and K-sorbate .To apply HACCP system, ingredients should be carefully selected.

**Ras cheese:** Normally Ras cheese processed from raw milk without starter, to compare between high quality Ras cheese and traditional Ras cheese, 100 kgs cow milk (FAT 3%, SNF 8.25) were divided into two equal parts, 50 kg were processed to Ras cheese from raw milk traditionally. The other part 50 kg were heated to 65/30 minutes, cooled to 37°C , 1.0% yoghurt culture were inoculated ,after 30 minutes powder rennet was added. The processing completed under aseptic conditions, the cheese stored at 4±2°C and humidity 85%.

**Karish cheese :** 100kg buffaloes skim milk warmed at 42°C, separated, divided into two equal parts ,the first was heated 85/15 minutes , cooled and 2.0% mesophilic starter were added, left 7 hours at 36±2°C for coagulation then Karish cheese making was completed under aseptic conditions. The second part is traditionally processed into Karish cheese.

**Skim milk powder:** made in Poland by VARIMEK.

**Palm oil:** Two types of palm oil ,from the kernel and the other from the fruit imported from Indonesia.

**Emulsifiers:** EGY Phos S20 and Joha NO with corrector .Citric acid and NaHCO3.Sodium bicarbonate.

#### Packaging materials:

Processed cheese was packed into 40-50 gm containers, each 10 containers packed on carton boxes.

The manufacture of processed cheese spread was carried out by using batch method in the Dairy Department, Faculty of Agriculture Mansoura University, according to the method described by EL-Assar, (1991)

Two separate batches of processed cheese were made, one with aseptic cheese and high quality palm oil.

The emulsifiers with corrector to adjust the pH  $5.70 \pm 0.05$  while the other batch used citric acid or NaHCO<sub>3</sub> for adjusting the pH., Diagram (1)

The ingredients were well mixed, heated in water bath to reach 90°C during 30 minutes.



Heating is continuously done for 30 minutes to have homogeneous.



Paste cooling down to 70°C, the preservatives were added, mixed well.



Filling the paste into plastic containers (50 gm capacity)



Left them at room temperature.

#### **Diagram 1. Manufacture of processed cheese spread**

##### **Organoleptic evaluation:**

The Processed cheese spread samples organoleptically evaluated when fresh, according to scheme reported by Meyer (1973). Regular scoring was carried out by panelists of the members of the dairy department, Faculty of Agriculture, Mansoura University.

The scoring sheet for processed cheese spread was as follows

Outer appearance	20
Internal appearance	40
Flavor	40
Total	100

## **RESULTS AND DISCUSSION**

### **Effect of heat treatment on the chemical and microbiological composition of cheese:**

It is clear from Table (1) that processing under aseptic condition resulted in cheese with higher chemical composition and lower total microbial and yeasts & molds counts. Aseptic cheese was considered HACCP cheese, while traditional cheese was for traditional processed cheese spread.

### **Development of processed cheese HACCP plan:**

**1. Prerequisite program.** There are several programs used in processed cheese production Murphy(2010).

**Line:** 1. Buildings and facilities must be of sound construction and good repair and designed to: permit easy and adequate cleaning and proper hygiene; minimize pest and environmental contamination; minimize cross contamination; provide adequate lighting in inspection areas; provide potable water supply; provide personal hygiene practice; control surrounding areas to reduce entry of dust, runoff, pests and other potential factory.

**Table 1. Composition of cheese from raw and heated milk**

Type of cheese Items	Ras fresh cheese Traditional	Ras fresh cheese Aseptic	Karish fresh cheese Traditional	Karish fresh cheese Aseptic
Total solid %	59.16	61.22	32.15	36.15
Fat %	28.12	29.34	0.30	1.42
Protein %	26.12	27.01	25.16	26.72
pH	5.71	5.82	4.71	4.78
Ash %	6.14	6.35	2.14	2.31
Total count	$42 \times 10^8$	$2 \times 10^8$	$311 \times 10^5$	$2 \times 10^5$
Lactic acid bacteria	$4.210^5$	$81 \times 10^5$	$61 \times 10^5$	$41.1 \times 10^5$
Yeast and moulds	$458 \times 10^2$	$3.1 \times 10^2$	$82 \times 10^2$	$1.2 \times 10^2$

**Contamination sources.** 2. Equipment used in the process must be designed, constructed, maintained and operated to allow for: effective cleaning of surfaces; contamination.

**Control; calibration and maintenance to ensure control.** 3. Persons who process product should establish hygiene practice to ensure: washing of hands prior to contact with product; training is provided on critical control points, allowable tolerances .

**Corrective actions required.** 4. All employees must: be provided documented procedures to ensure the processes do not pose a health risk; adhere to documented procedures.

**Involved in the preparation of a HACCP system.** 5. A documented sanitation program must exist that includes: equipment cleaning; housekeeping audits and associated corrective.

**Actions; pest control; waste disposal; bin inspections.** 6. Incorporated into the existing documentation there must be: process flow charts and critical control points; monitoring mechanism for these control points; corrective action process; traceable

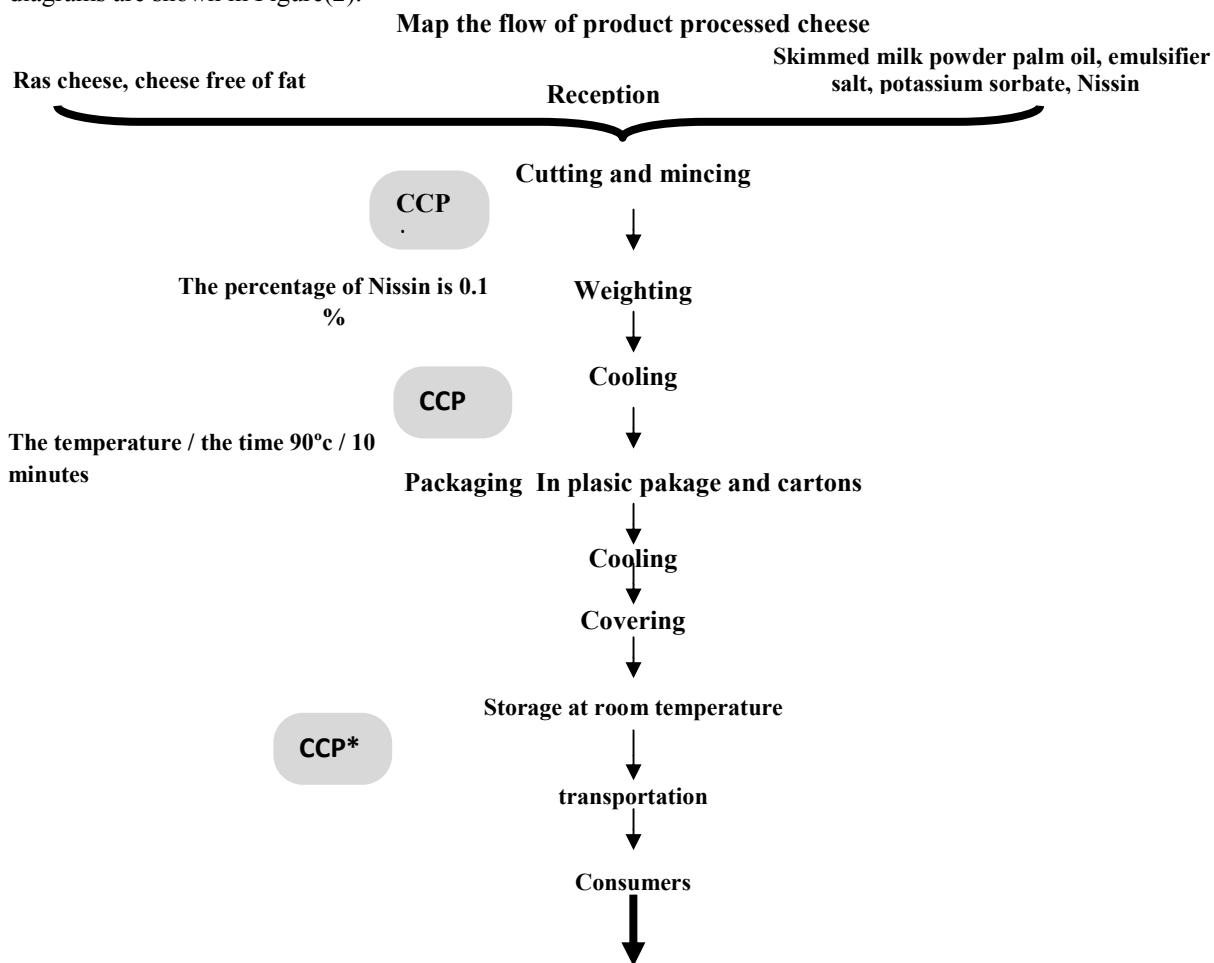
Records. 7. A formalized customer complain process must exist that includes a product recall process; Table (2).

**Table 2. Processed cheese Production description form**

<b>Components</b>	Ras cheese , Karish cheese free of fat , skimmed milk powder , palm oil , emulsifying salts , sodium sorbate and Nissin
The product properties	Fresh processed cheese obtained from cooking the ingredients.
How to use the product	Ready to eat immediately.
Packages	Processed cheese – filled into aseptic plastic container 40.or 50 gm. 10 cups packed in one carton box .
Place of sale and distribution	Egyptian market
Instructions on the label	The name of product , its components , the date of production , the date of expire , the weight , and number of operation which is consists of English character and represent name of operator plus four number beside the English character and represent the actual production date
Special instruction of transportation , distribution and storage	Transfer in a cleaning cars under a temperature not exceed than 5 degrees Celsius
Product users	All ages ( free of allergens )
The chemical properties	After 60 days of storage. Degree of acidity 0.23 % , pH ( 5.84 ) , the water content 44.00 % , the fat content 31.20% , the protein content 19.80%
The microbiological properties	After 60 days of storage. The total bacteria count was ( $0 \times 10^{10}$ unit made up of colonies / ml The fungi count was ( $1 \times 10^2$ )unit made up of colonies / ml
The sensory evaluation	After 60 days of storage. Outer ( 19 / 20 ) , the texture ( 38 / 40 ) tasting ( 39/40) so the total scoring points of the final evaluation is ( 96/100)

**Process flow diagram:**

Processed cheese steps and process flow diagrams are shown in Figure(2).



**Figure 2. Illustrating the Map Flow of a produced cheese**

\* CCP: critical control point

Although ingredients were highly improved, still there are three critical control points = CCP namely  
 1- Cutting and mincing step. 2-Cooking the mixture.  
 3- Storage of cheese.

**To overcome and find good solution for the three CCP , Table (3) was applied as a guide:**

HACCP control chart. The HACCP control chart Table (3) shows all the potential critical hazards that can occur during processing processed cheese production line. It is the most essential part of the whole HACCP plan, which is the organisation analysis and documentation of the CCPs. The steps that contain those CCPs will be emphasized during production.

Cutting and mincing step. Following the Sanitation Standard Operation procedures SSPOS and good manufacturing practice GMPS first, cleaning the mincer unit with hot water 94°C for 6 minutes, followed with H<sub>2</sub>O<sub>2</sub> solution and finally rinsing with hot water Table (3).

2-Cooking the mixture. Concerning the second points, the same cleaning and Disinfection steps as well adjust the 10 minutes and adjust the nissin at 0.1% accurate. Table (3).

3-Storage of cheese. Storage, controlling. The storage room temperature s should be 4±2°C. Applying FIFO system = First in First out Table (3).

Chemical and microbial properties of cheeses are shown in Table (4).

**Egyptian Standards are take as a measure of comparison.**

Applying of HACCP .increased the total solids, pH cheese and protein contents of the cheese .At mean time lowered the total microbial count of cheese .HACCP cheese specifications is nearer to the Egyptian Standards El-Hofy et al (2010).

10 Judgers were selected from Mansoura University to give their opinions about both cheeses. Unknown Samples offered with numbers. The averages of their opinions are tabulated in Table (5).

Flavor including the taste and odor of cheese, gained higher scoring points for HACCP cheese (39/40) while traditional cheese gained only (31/40).Following HACCP system the cheese gained (96/100)total scoring points.

**Table 3. HACCP control chart.**

Critical control point	The illustration risks	The critical limits	Who	When	How	What	The correcting	The materialization
The reception	Chemically presence of preserved substances	The free of the producing from preserved substances	Quality supervisor	Every importing	The analysis of finding of preserved substances	The analysis result	Refusing of Raw material	Checking the receipt report and analysis resulting
The addition of Nissin	Chemically As a result of increasing in the Nissin percent to the allowed percent	The adding percent must be not more than 0.1%	The department engineering	At every operation	By using an standard balance	The weight	By modification the a mount of raw substance to the addition substance	The receipt report , review the complains , and internal reviews
The cooking	Biologically As a result of contamination of food poisoning microbes	The temperature must not increase than 90 degree Celsius	Quality supervisor	At every operation	The thermometer Or a thermal standard	The temperatur e degree inside the producing	Repeat it a thermal treated until reach to the demand temperature degree	Thermometer calibration Review the reports
The packing and welding	Biologically As a result of contamination of food poisoning microbes	the safe of welding	Quality supervisor	At every operation	The safe of welding	The safe of welding	Isolate the opening packages and review the welding machine	Reviewing the records
The final storage	Biological as a result of increasing in bacterial load and the expire date	The temperature should not be increased than 4 degree Celsius	Quality supervisor	At the beginning of the day and at the end of the day	Thermometer Or a thermal standard	The degree of the preserved fridge	Distinguish and isolate the produce knowing the result and avoid it and ensuring the degree of temperature after the fixing and ensuring that there is no a produce un good reach to the citizen	Thermometer calibration Review the reports

**Table 4. Comparison between HACCP and traditional cheese.**

Items	Egyptian Standards	Traditional cheese	HACCP cheese
Acidity%	-----	0.29	0.23
pH	-----	5.40	5.84
T. solids%	(Moisture Nat exceed) 49	44.23	51.72
Fat%	28.05	29.5	28.62
Fat/DM%	55.0	66.6	55.52
Protein%	-----	17.22	19.40
Protein/T.S%	-----	38.93	37.50
Total Microbial count	10 cells/gm cheese	1700	0.8×10 <sup>2</sup>
Moulds &yeast	10 cells/gm cheese	43×10 <sup>2</sup>	1×10 <sup>2</sup>

**Table 5. Organoleptic evaluation of traditional and HACCP cheese**

Scoring points	Traditional cheese	HACCP cheese
Internal appearance (20 points)	12	19
Outer appearance (20 points)	28	38
Flavors (40 points)	31	39
Total	71	96

## CONCLUSION

The HACCP system in this study for processed Cheese line manufacture is developed step-by-step based on the 10 steps mentioned in the literature review flow chart. The prerequisite program was provided to deal with some hazards before the production; therefore, to simplify the HACCP plan. The product description

was used to alert the consumer to the potential hazards in the final products. By answering the questions in the decision plan, the critical control points were determined. Finally, the HACCP control chart was developed to include components of several HACCP principles which are critical limits, monitoring, corrective action and responsibility. three CCPS were found in the production in this cheese plant flowing the sanitation rules, the three CCPS were solved.

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### تحديد نقاط التحكم الحرجة (HACCP) في صناعة الجبن المطبوخ

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معظم الجبن المطبوخ ينتج بالطرق التقليدية العادلة دون استخدام النظم الحديثة (الهاسب) لاكتشاف النقاط الحرجة المسئولة عن منتج غير مطابق للمواصفات الصحية والذي يصعب تسويفه محلياً. وهدفت هذه الدراسة المقارنة بين جبن ينتج بالطرق التقليدية واخر يطبق عليه نظام تحديد نقاط التحكم الحرجة (الهاسب). ونظراً لأن المواد الداخلة في الصناعة تعتبر من اهم النقاط الحرجة والتي تؤدي الى تصنيع جبن غير مطابق لمواصفات المواد الداخلة في صناعة الجبن موضوع الدراسة وهي الجبن الراس ،الجبن القرش، اللبن الفرز المجفف، زيت النخيل، املاح الاستحلاب ، الماء، المادة الحافظة وهي النisin وسوربات البوتاسيوم وقد تم انتاج جبن راس تحت ظروف صحية عالية بالبسترة واستخدام البادي واخر بالطرق التقليدية من لبن خام وبالمثل الجبن القرش تم انتاجه بالطرق التقليدية واخر تحت ظروف صحية مثالية واستخدمت املاح استحلاب مع مواد التصحیح للوصول الى pH المناسب واخرى عادلة مع استخدام حمض الستريك وبيكریونات الصوديوم لضبط pH وتم تصنيع الجبن المطبوخ بالطريقين التقليدية وباستخدام نظام (الهاسب) وتم تحديد ثلاثة نقاط حرجة في خط الانتاج هي 1- مرحلة الفرم والتقطيع ودقة وزن النيسين، 2- الطبخ، 3- التخزين . وقد تم معالجة النقاط الحرجة الثلاثة وتم انتاج جبن جيد جداً اذا ما قورن باستخدام الجبن المصنوع بالطرق التقليدية حيث كان جبن الهاسب قريب جداً من المواصفات القياسية المصرية في الاعداد الميكروبية وحصل على تقييم حسي عالي 96% بينما حصل الجبن التقليدي على 71% وكانت الاعداد الميكروبية عالية لحد ما عما هو مشار اليه في المواصفات المصرية ولذلك ينصح باستخدام نظام الهاسب في انتاج الجبن المطبوخ ليكون امن صحياً وله اسوق كبيرة داخلياً وخارجياً.