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IMPLEMENTATION OF HACCP TO CHICKEN SAUSAGE PRODUCTION LINE

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ABSTRACT

Nowadays Hazard Analysis of Critical Control Points (HACCP) has become a prerequisite for transactions involving food products. Whereas the implementation of the Hazard Analysis Critical Control Point (HACCP) system to chicken products is of great importance in order to produce microbiologically safe foods. Chicken sausage is one of the popular foodstuffs among products of chicken meat. Therefore a thorough HACCP analysis of this product has become an important issue for public health. This paper presenting guidelines for the application of HACCP and focuses on the flow diagrams based on the production line of manufacture chicken sausage in a small producing unite in Agriculture Research Center, and presents an analysis of the hazards and of the critical control points (CCP) and monitoring them then verification to confirm that the HACCP system is working effectively.

Keywords: HACCP; Chicken sausage.

INTRODUCTION

In the early 1960s, HACCP concept was originally developed as a microbiological safety system by the Pillsbury Company, in a joint effort with the National Aeronautic and Space Administration (NASA) and the US Army Laboratories at Natick. It was used as a zero defect programmeme aiming at the safe production of foods that would be consumed in zero gravity to ensure that the foods for the space programme were free of all pathogens that could cause illness to astronauts during space travel. Thereafter, the food industry introduced the same system to prevent any risk to the health of its consumers. It was first applied to low-acid can foods with great success (Bauman, 1974; Bryan, 1992 and Michalis and Ioannis 2000).

The concept of Hazard Analysis of Critical Control Points (HACCP) is a preventive, structured, systematic and documented approach to ensure food safety (Buchanan, 1990). HACCP is an effective precautionary control system that, if applied correctly and systematically, offers the means for the identification and assessment of any possible physical, chemical and microbiological hazards, the detection and control of critical points in all food production steps (Archer, 1990). Hazard assessment and critical control points (HACCP) is worldwide considered as an effective and rational means of assuring food safety, which can be applied throughout the food chain from primary production to final consumption. It is a system aiming at the production of zero defective products which separates the acceptable from

the non-acceptable (Mauropoulos and Arvanitoyannis, 1999). The Codex Committee on Food Hygiene (FAO/WHO, 1996) stated that, microbiological safety of foods is principally assured by control at the source, product design and process control, and the application of good hygienic practices during production, processing, and handling, distribution, storage, sale, preparation and use. This philosophy is the basis of the HACCP.

Mortimore and Wallace (1998) in brief, HACCP is applied through taking a number of easy steps:

- Look at your process/product from start to finish.
- Decide where hazards could occur.
- Put in controls and monitor them.
- Write it all down and keep records.
- Ensure that it continues to work effectively.

Sperber (2005) mentioned that, in 1972, The Pillsbury Company in the US began the application of its HACCP concept to the manufacture of its consumer food products. This primordial HACCP system consisted of three principles:1) Conduct hazard analysis, 2) Determine critical control points and 3) Establish monitoring procedures.

While Martyn (2000); Mc Swane et al., (2003) and Taylor (2008) reported that, in 1993 the Codex Alimentarius Commission elaborated a 12-part method (guidelines) for the application of HACCP. This has achieved international recognition and as such, has become the definitive method of applying HACCP principles. These guidelines include a sequence of activities for the application of HACCP principles, which are outlined in:

1:Assemble the HACCP team.
2:Describe product.
3:Identify intended use.
4:Construct flow diagram.
5:On-site verification of flow diagram.
6:Conduct a hazard analysis: Listing potential hazards and identify preventive measures for significant hazards to reduce or eliminate them.
7:Determine the critical control points (CCPs).
8:Establish critical limit(s) for each CCP: Set target levels and tolerances, which must be met to ensure the CCP is under control.
9:Establish a monitoring system for each CCP: it must be able to detect loss of control at the CCP (those occurrences outside the Critical Limits).
10:Establish the corrective actions to be taken when monitoring indicates that a particular CCP is not under control (a critical limit has been exceeded).
11:Establish procedures for verification to confirm that the HACCP system is working effectively.
12:Documentation and record keeping: documentation examples include the hazard analysis, all the reference documents used in the risk assessment, CCP determination and critical limit determination. Record keeping examples include deviations and corrective action reports. This may be the only part of the HACCP plan that will be audited or reviewed by customers or regulators.

Considering that, the first 5 steps are preliminary procedures while subsequent 7 steps are HACCP principles.

Sausages are emulsions of the oil in water type; the continuous phase is water and soluble compounds, the disperse is oil, and the emulsifier is protein (Pereira et al., 2000). Chicken meat and its products have experienced increasing popularity and become widely spread all over the world due to offering an excellent source of animal protein and this meat is not the focus of many religious or cultural dietary laws. Chicken sausage is one of the popular foodstuffs among these products (Barbut, 2001).

The aim of this research is expositions that, how to apply the HACCP system on line of chicken sausage production through conducts a hazard analysis, determine CCPs, monitoring them; documentation and verification for obtained the high safe product.

MATERIALS AND METHODS

1. Materials:

Chicken :

Deboned meat of chicken from supplier to line of manufacture chicken sausage in a small producing unite in Agriculture Research Center.

Other ingredients :

Skim milk powder, spices & sausage seasonings, garlic, sheep tail fat, salt (sodium chloride), sodium phosphate and natural casings were collected from a supermarket at Giza. While extruded soy obtained from Food Technology Research Institute.

Culture media for the microbiological assay :

Nutrient agar medium (American Public Health Association "A.P.H.A", 1976) and (Difco, 1984) was prepared for the determination of total plate bacterial count. Whereas MacConkey agar medium was used for coliform bacteria counting. Baird parker agar base medium was used for counting the *Staphylococcus aureus* bacteria and potato dextrose agar medium was used for yeasts and molds count (Difco, 1984). On the other hand for detection of *Salmonella* and *Shigella* used 3 media: Buffered pepton as a pre-enrichment medium, while tetrathionate broth as a selective enrichment broth and the Salmonella-Shigella-agar as a selective plating medium (FDA, 1978 and FAO, 1979).

2. Methods:

-Application of HACCP system:

Horchner et al., (2006) recommended these steps to implementation the HACCP system.

1.Assemble the HACCP team (Step1):

2.Fill out product description and intended use forms (Steps 2 and 3):

3.Construct a process flow diagram and conformable with real steps on plant (Steps 4 and 5):

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

5.Principle 2: Determine Critical Control Points (CCPs)(Step 7):

For each process step where a significant hazard has been identified using CCP decision tree Fig.(1) and your own common sense to determined CCPs.

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

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

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

Fill out "HACCP plan worksheet" to fulfillment previously steps.

9.Principle 6: Establish verification procedures (Step 11):

Microbiological analysis methods:

Samples were taken from steps, which considered CCPs: Chicken meat samples were taken randomly directly when received by sterile knives and transported to the laboratory in icebox. In the same manner sheep tail fat, natural casings, minced garlic and the sterilized bottle, which contain cooled water sample (approx. 150 ml). Also CCPs samples which taken from different steps in sausage processing plant. Whereas spices & seasonings, skim milk powder, extruded soy transported to the laboratory without refrigeration (Metaxopoulos et al., 2003).

Sample preparation: 10gm. of each sample (CCPs) were mixed with 90 ml of sterile peptone solution (9 gm peptone / 1 L distilled water) to give 1/10 dilution. Serial dilutions were prepared to be used for counting several types of bacteria & yeast and molds.

Total plate bacterial count, coliform count, *Staphylococcus aureus* count and yeasts and molds count were determined according to the procedures by A.P.H.A (1976) and Difco (1984). On the other hand the presence or absence of *Salmonella* and *Shigella* were determined according to the methods described by FAO (1979).

Chemical quality attributes:

1. Determination of thiobarbituric acid (TBA) :

TBA was determined according to the method of Pearson (1991) measurement was carried out colorimetrically at 538 nm. The TBA values were calculated by multiplying the absorbance by the factor of 7.8 and the results were represented as mg malonaldehyde / kg sample.

2. Determination of total volatile nitrogen (T.V.N.) :

T.V.N was determined by the method of Winton and Winton (1958) results were represented as mg T.V.N /100 gm sample.

10.Principle 7: Documentation and record keeping (Step 12):

-Processing/Preparation of chicken sausage :

The minced chicken meat was mixed with spices & sausage seasoning, salt, minced garlic, skim milk powder, soaked soy extrudate (extruded soy : water ratio 1:1and left 20 min. then minced), minced sheep tail fat, sodium phosphate (dissolved in water) and added cold water or flake ice in a kneading machine until emulsion was produced. Then the emulsion was stuffed into natural casings (from sheep) of different size, using a mechanical stuffer. After that put it in foam plates and packed in polyethylene bags, labeled and the finished product was frozen in the deep freezer at -18°C.

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RESULTS AND DISCUSSIONS

-Application of HACCP system during manufacture chicken sausage :

1. Assemble the HACCP team (Step1):

The core HACCP team include Quality Assurance/Technical, Engineering, microbiologist, HACCP experts and statistical Process control.

2. product description and intended use (Steps 2 and 3):

Product	Chicken sausage (a frozen poultry product), containing chicke meat and other ingredients (sheep tail fat, spices & seasonin minced garlic, skim milk powder, soaked soy extrudate, sal sodium phosphate). Stuffed in natural casing. Packed i polyethylene bags.
Sold in/ Shelf life/ Storage temp.	Supermarkets/ 3 months / -18°C.
Intended user	Public community.
How it used?	After adequate cooking (heated until the core temperature wa raised to 72°C approximately).

3. Construct a process flow diagram (Steps 4 and 5):

Fig.(2): Flow diagram of chicken sausage.

4. HACCP plan work sheet (Steps 6,7,8 and 9):

HACCP PLAN WORKSHEET						
CCPs process steps	**Hazards**		**Preventive measures**	**Critical limits**	**Monitor procedures**	**Corrective actions**
	type	**hazard**				
1.Receive						
1.a) Chicken deboning	B	-Presence of *Salmonella*, *Staph.*, coliform bacteria,Yeast & Mold).	-Testing and visual inspections.	-Absence of *Salmonella* and *Shigella*. Microbial legal limits (**E.S.**)	-*Salmonella* and *Shigella* detection. Microbiological analysis testing.	-Reject or not use and execute it and contact supplier or change him.
	C	-Lipid oxidaion formed toxic substances.	-Legal limit of T.B.A. value when receiving.	-The T.B.A value below to standard value.	-Evaluation the T.B.A. value.	
	P	-Foreign bodies (bones, cartilages, stone,….).	-Visual inspections and quality assurance.	-Free from any foreign matters.	-Visual inspection.	-Good manually trimming and washing.
1.b) skim milk powder	B	-Microbial contamination (presence of *Salmonella*).	-Obtain certificate of conformance from suppliers.	-Absence of *Salmonella*. Microbial legal limits (**E.S.**).	-*Salmonella* detection. Microbial testing.	-Reject or not use and execute it and change him.
	P	-Physical contamination (any foreign objects).	-Check packaging integrity on arrival and visual inspection and sieve.	-Free from any foreign objects.	-Visual inspection.	-Sifting and use refine SMP.
1.c) Soy extrudate	B	-Pathogens.	-Adequate Storage and FIFO principles “first in, first out”.	-Microbial legal limits (**E.S.**).	-Microbial testing and visual.	-Reject or execute it and contact supplier or change him.
	P	-Foreign bodies (stones, insects,….others	-Check packaging integrity on arrival and visual inspection.	-Free from any foreign bodies.	-Visual inspection.	-Manually pick out foreign bodies.

Continued.

1.d) Spices & seasonings	B P	-Pathogens. -Foreign bodies	-As above. -As above.	-As above. -As above.	-As above. -As above.	-As above. -As above.
1.e) Minced garlic	B P	-Pathogens. -Foreign bodies	-As above. -As above.	-As above. -As above.	-As above. -As above.	-As above. -As above.
1.f) Sheep tail fat	B	-presence of *Shigella* and Pathogens	-Storage frozen& FIFO principles.	-Absence of *Shigella* Microbial lega l limits (**E.S.**).	-Shigella detection. Microbial test.	-As above.
	P	-Foreign matter (cartilages).	-Visual inspections.	-Free from any foreign matters.	-Visual inspection.	-Good manually trimming.
1.g) Water and Ice water	B	-Pathogens (*E.coli,Shigella*)	-Certificate of analysis from water authority of an on-site sample.	-Absence of *Shigella.* Microbial legal limits (**E.S.**).	-Shigella detection. Microbial testing.	-Not use and contact supplier.
	P	-Foreign body (impurity).	-Use water filters.	-Purity of water.	-Visual inspection and filtration.	-Use water filters or change filters.
1.h)Natural casings	B	-Microbial contamination (*E.coli, Shigella*)	-Adequate storage (preserve with salt and frozen).	-Absence of *Shigella.* Microbial legal limits (**E.S.**).	-Shigella detection. Microbial testing.	-Reject or execute it and contact supplier (or change).
	P	-Foreign body.	-Visual inspections and good washing.	-Free from any foreign matters.	-Visual inspection.	-Good washing and cleaning.
2.Additives and mixing	B	-development of microorganisms due to high temp. in the processing area.	-Monitoring temp. ≤12°C. Using suitable equipment and effective cleaning, Staff hygiene.	-Absence of *Salmonella* and *Shigella*. Microbial legal limits.	-Salmonella and Shigella detection. Microbial testing.	-Reject or execute Control-receiving step. GHP & GMP.
	C	contamination from additives, staff, equipment. -Lipid oxidaion formed toxic substances.	-Quick Manufacture minimize exposure to oxygen; monitoring temp. ≤12°C	-The T.B.A value below to standard value.	-Evaluation the T.B.A. value.	-Reject and execute it and control in time / temp. (≤-12°C)during manufacture.
	P	-Foreign bodies	-Pest control when arrived	-Free from any foreign	-Visual inspection.	-Control-receiving step.

Continued.

			additives and clean utensils.	matters.		pick out foreign bodies.
3.Stuffing	B	-As above and cross contamination from natural casings.	-As above and proper storing casings (salting and freezing).	-Absence of *Salmonella* and *Shigella*. Microbial legal limits.	-Salmonella and Shigella detection. Microbial testing.	-Reject, execute it, control-receiving and storing casings step and reject, execute unacceptable casings. GHP (staff & place) and GMP.
	C	-Lipid oxidaion formed toxic substances.	-Stuffing quickly for minimize exposure to oxygen; monitoring of	-The T.B.A value below to standard value.	-Evaluation the T.B.A. value.	-Reject or not consumed and execute it and control in time / temp. (≤-12°C) during manufacture.
	P	-Foreign bodies.	temp. (≤12°C). -Clean equipment and surfaces.	-Free from any foreign matters.	-Visual inspection.	-Reject.
4.packaging & labeling	C	-An allergic by some food components (if not mention by label and consumed).	-Check product labels information (highlighting any allergenic components).	-Mention all product-contents.	-Visual inspection (check label).	-Quarantine product and replace label.
		-Untraceable product (inability to trace and recall product resulting in unfit product in market place)	-Check codes (effective date and batch coding).	-correct code applied, legible label.	-Visual inspection (check label).	-Quarantine product and replace label.
5.Freezing at –18°C	B	-growth pathogenic micro-organisms resultant low temperature not achieved (abused temp.) & poor freezer cleaning.	-Control of freezer temp. which restricts microbial growth, monitoring of internal product temperature on exit <-18°C and effective cleaning (procedures & practices).	-Freezer temp. <-18°C. -Absence of *Salmonella* and *Shigella*. Microbial legal limits (**E.S.**).	-Check freezer and product temp. by thermometer. -Salmonella and Shigella detection. Microbiolog-ical analysis test.	-Alert procedures thus adjust temp. control on freezer. -Discard and execute if contamina-tions is evident.
	C	-Lipid oxidaion formed toxic substances.	-Packaging integrity for minimize exposure to oxygen; monitoring of freezing temp. (≤ -18°C).	-The T.B.A value below to standard value.	-Evaluation the T.B.A. value.	-Reject or not consumed and execute it and control in freezer temp. (≤-18°C).

 # B= biological hazard, C= chemical hazard, P= physical hazard and (E.S.)= Egyption Standards.

5. Establish verification procedures (Step 11):

Catherine, (1990), demonstrated that, the HACCP system was designed to ensure the safety of meat and poultry products, since receiving raw materials and during processing operations by controlling all steps of production. Thus in our research from fig (2), which presented flow diagram for manufacture of frozen chicken sausage with estimating the CCPs, we determined 5 critical control points, including:1) Receiving raw materials (deboned chicken, additives and stuffing materials); 2) Additives and mixing step; 3) Stuffing step; 4) Packing and labeling step (label's data) and 5) Freezing at -18°C. Also some microbiological and chemical analysis were used to monitor and verificate HACCP system to insure producing high quality and safe products for consumers according to the Egyptian Standards as critical limits.

I. Microbiological analysis:

Receiving raw materials was a CCP step thus we should assure that the raw materials should having high degree of safety and storage conditions should be good before its use. According to Abd El-Razik (1997) who referred that, since the receiving step in chicken sausage manufacture was determined as a Critical Control Point (CCP), much attention must be taken when analyzing the microbiological quality of raw chicken carcasses and should be kept under frozen storage or even at chilling temperatures until manufacture.

Table (1): Microbiological analysis of received raw materials [CCP1].

	Main material	Additives							Stuff material
	Chicken deboning	Skim Milk powder	Soy extrudate	Spices & seasonings	Minced garlic	Sheep Tail Fat	Water	Ice water	Natural casings
T.B. count	168×10^2	1×10^2	4.45×10^2	1.05×10^2	5×10^2	1.7×10^2	0.1×10^2	0.07×10^2	0.7×10^2
Coliform count	0.45×10^2	0	0.7×10^2	0.1×10^2	0.03×10^2	0	0	0	1.2×10^2
***Staph.* count**	2.5×10	0	0.5×10	0	0	2×10	0	0	0
Y&M count	14.5×10	0.1×10	0.8×10	0.5×10	1.5×10	1.8×10	0	0	0
Salmonella	–	–	–	–	–	–	–	–	–
Shigella	–	–	–	–	–	–	–	–	–

From the data in Table (1), showed that, when receiving raw materials (CCP1) the total bacterial count was 168×10^2, 1×10^2, 4.45×10^2, 1.05×10^2, 5×10^2, 1.7×10^2, 0.1×10^2, 0.07×10^2 and 0.7×10^2 cfu/g, Colifrom count was 0.45×10^2, 0, 0.7×10^2, 0.1×10^2, 0.03×10^2, 0, 0, 0 and 1.2×10^2 cfu/g, while *Staph. aureus* count was 2.5×10, 0, 0.5×10, 0, 0, 2×10, 0, 0 and 0 cfu/g and finally yeast & mold count was14.5×10, 0.1×10, 0.8×10, 0.5×10, 1.5×10, 1.8×10, 0, 0 and 0 cfu/g for chicken deboning, skim milk powder, soy extrudate, spices & seasonings, minced garlic, sheep tail fat, water, ice water and natural casings samples respectively. Furthermore no detection of *Salmonella* and *Shigella* was noticed in any raw materials samples. Therefore all raw materials results are in accordance with the Egyptian Standards [Chilling poultry and rabbits 2005/1651; Dried milk 2005/1648;

Soya protein products 2005/3640; Frozen garlic 2007/3273; Edible tallow which used in food-industry 2005/471; Water, ice and standard methods for test. Part1: drink water 2007/1-190].

Table (2):Microbiological analysis during manufacturing sausage[CCP2, CCP3, CCP5].

	Additives and mixing [CCP2]	Stuffing [CCP3]	Freezing –18°C [CCP5]
T.B. count	98.5×10^2	111.5×10^2	109×10^2
Coliform count	0.40×10^2	0.42×10^2	0.41×10^2
***Staph.* count**	3×10	3×10	2.8×10
Y&M count	9×10	9×10	8.4×10
Salmonella	–	–	–
Shigella	–	–	–

Data in Table (2), cleared that, during manufacture steps the total bacterial count was 98.5×10^2, 111.5×10^2 and 109×10^2 cfu/g, colifrom count was 0.40×10^2, 0.42×10^2 and 0.41×10^2cfu/g, while *Staph. aureus* count was 3×10, 3×10 and 2.8×10 cfu/g and finally yeast & mold count was 9×10, 9×10 and 8.4×10 cfu/g. While *Salmonella* and *Shigella* detection was negative for additives & mixing, stuffing, and freezing steps. This result agree with Oteiza et al., 2003 who found that, the range of values of the microorganisms analyzed in 30 sausage samples were: total microbial counts 6.3×10^3–2.1×10^8 cfu/g (40% of the isolated colonies were Gram positive and 60% Gram negative),molds and yeasts 8.9×10^1–6.3×10^4 cfu/g, total coliforms 1.4×10^1-1.1×10^3 MPN/g, fecal coliforms 7.0– 1.5×10^2 MPN/g. *Staph. aureus* and B. cereus were not detected. And Álvarez-Astorga et al. 2002; Gill et al. 1997 and Egyptian Standards [Frozen poultry sausage 2005/2911].

II. Chemical quality attributes:

The TBA test is widely used for muscle foods (Gray, 1978; Pikul et al., 1984). Lipid peroxides formed by nonenzymatic oxidation and/or lipoxygenase enzyme, can be further metabolized to carbonyl compounds and fatty acids, which affect flavor and form some toxic substances (Cerise at al., 1973). Thus the oxidative rancidity measured by evaluation TBA values.

Abd El-Razik, (1997) mentioned that, total volatile nitrogen (TVN) could be used as an indication for protein degradation during frozen storage. Total volatile nitrogen (TVN) was determined as an index of protein break-down in stored chicken patties.

Table (3): Thiobarbituric acid value T.B.A. & total volatile nitrogen T.V.N. for CCPs.

CCP	T.B.A. (mg malonaldehyde/kg)	T.V.N. (mg TVN/100g)
Receiving chicken deboning [$CCP1_a$]	0.410	13.94
Additives and mixing [CCP2]	0.732	16.09
Stuffing [CCP3]	0.770	16.43
Freezing –18°C [CCP5]	0.778	16.47

The data in Table (3), cleared that, the TBA values were 0.410, 0.732, 0.770 and 0.778 mg malonaldehyde/kg. for $CCP1_a$, CCP2, CCP3 and CCP5. There was an increase in the TBA value during manufacturing and freezing at-18°C. This increase proved that, some fat was oxidized, and this increase dependent on TBA value in raw chicken, exposure to oxygen, elevated temperature during manufacture and increase fat content (add sheep tail fat) conform with Abd El-Razik, 1997 and Van Laack, 1994.

On the other hand the results in Table (3), indicated clearly that, the amount of TVN was 13.94, 16.09, 16.43 and 16.47 mg TVN/100g.sample for $CCP1_a$, CCP2, CCP3 and CCP5. Therefore, continuous increase in TVN was noticed. This increase might be attributed to the break-down of nitrogenous substances by microbial activity (specially with raising time/temperature during manufacture) and depended on the amounts of TVN in raw chicken.

These results are in accordance with Egyptian Standards [Chilling poultry and rabbits 2005/1651 and Frozen poultry sausage 2005/2911] as critical limits.

6.Documentation and record keeping (Step 12):

Documentation was completed previously by listing of the HACCP team, product description and intended use, flow diagram of the entire process indicating CCPs, hazards and preventive measurements for each CCP, critical limits for each CCP, monitoring systems, corrective actions for deviations, record keeping, and procedures for verification.

CONCLUSION

The results in this research indicated that, the raw materials used in chicken sausage production were highly safe thus the final product was also highly safe due to application of HACCP system. Implementation of HACCP system is necessary in order to produce a final safe food products.

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تنفيذ الهاسب على خط إنتاج سجق الدجاج

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في الوقت الحاضر أصبح نظام تحليل المخاطر و تحديد نقاط اتحكم الحرجة (الهاسب) أحد المتطلبات الأساسية في إنتاج الغذاء.

بناءًا على ذلك أصبح تطبيق نظام الهاسب في إنتاج منتجات الدواجن (سجق الدجاج أحد هذه المنتجات الشائعة و المفضل لدى الكثير من المستهلكين) أهمية كبيرة لانتاج غذاء أمن ميكروبيولوجيا مما يؤثر إيجابا على الصحة العامة.

يهدف هذا البحث إلى تقديم الخطوط الأساسية لتطبيق نظام الهاسب على خط إنتاج سجق الدجاج في وحدة الإنتاج بمعهد بحوث تكنولوجيا الأغذية - مركز البحوث الزراعية - الجيزة. ومن خلال ذلك نعمل على تحليل المخاطر و نحدد نقاط التحكم الحرجة و نراقبها و بذلك نتأكد من فاعلية نظام الهاسب.

وأوضحت النتائج أنه بتطبيق هذا النظام فإن الناتج النهائي من سجق الدجاج كان آمن صحيا و خالي من الميكروبات المرضية.