Journal of Food and Dairy Sciences

Journal homepage: www.jfds.mans.edu.eg
Available online at: www.jfds.journals.ekb.eg

Implementation of ISO 22000 System in Spaghetti Industry

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ABSTRACT

The ISO 22000 Food Safety Management System has been applied to the spaghetti industry, in order to enhance food protection, protect customers, increase customer trust and improve cost efficiency. This experiment was carried out in North Cairo Flour Mills and Bakeries Company, Pasta Factory, Shubra El Khema, Cairo, Egypt, all stages were followed up from the receiving wheat flour extract 72% to spaghetti production and storage. Beginning with the appointment of the food safety team and that the infrastructure is suitable for the production process, the spaghetti product was described, a flow chart was constructed of the manufacturing process, the hazard was analyzed and identification, the sieving stage, drying stage and packaging stage were identified as critical control points (CCPs), while stage of receiving materials and stage of storing the product have been determined as operational prerequisite programs (OPRPs) and the effectiveness of implementing the HACCP plan is verified. The microbiological analysis of swabs from workers and surfaces was within the allowable limits. The results showed that no significant differences between the chemical composition of spaghetti. The heavy metal concentration of packaging material to use in packing spaghetti was within the allowable limits.

Keywords: ISO 22000, Food safety, HACCP, Spaghetti.

INTRODUCTION

As a result of food safety globalization trends, there was a need within the spaghetti industry for controlling food safety especially due to customer's demands and government's regulations. The best way to ensure food safety was with the implementation of food safety management systems which is represented in (ISO 22000, 2018).

Pasta is a wheat-based food consumed worldwide for its flavour, low cost and nutritional value. Durum wheat semolina (*Triticum turgidum ssp. durum*) is the preferred and most often used raw material for the production of good-quality pasta (Simonato *et al.,* 2015).

Food safety is an international challenge requiring close cooperation between countries in agreeing standards and systems. European consumers not only require much higher dietary quality and hygiene and health standards in the products they purchase but also look for certification and protected origin products (national or geographic) and processing methods. The hazard analysis and critical control points (HACCP) system is a science-based system created to identify specific hazards and actions to control them in order to ensure food safety and quality. Hazard is a biological, chemical or physical agent in or condition of, food with the potential to cause an adverse health effect according to Codex Alimentarius. The adoption of a completely new system of managing food safety compared to HACCP led to the development of ISO ٢٢٠٠٠, which is the new international generic standard for food safety management systems (FSMS). It defines a set of general food safety requirements that apply to all organizations in the food chain. ISO 22000 controls food safety hazards through prerequisite programs (PRPs) and HACCP plans (Varzakas, 2016).

ISO 22000:2018 consists of four major elements: the HACCP plan, the PRP, the quality management system, and the appropriate sites, facilities, and equipment. The HACCP plan is the most important element of the standard. ISO 22000 was aimed at constructing an FSMS for a given enterprise and is consistent with the ISO requirements of the so-called "plan, do, check, action" (PDCA) approach. ISO 22000:2018 conforms to the principle of the CODEX HACCP 7 and 12 application steps. The new standard places a greater emphasis on risk-based thinking by integration the concept of risk assessment into the ISO 22000:2018 system and elevating it to the highest levels of management participation and commitment in order to implement and communicate food safety policies (Chen *et al*., 2019). The purpose of this study is to apply (ISO 22000, 2018) in the spaghetti process for producing safe and quality product to comply with customer's requirements.

MATERIALS AND METHODS

Materials:

Wheat Flour 72% extraction:

Wheat flour sample from Russian wheat (72% extraction), was taken from Al Kawther Flour Mill, El Salam City, Cairo, Egypt.

Pasta:

Spaghetti was taken from Pasta Factory, Shubra El Khema- Cairo, Egypt. Spaghetti was sampled in three times from two different stages in the industry process. The first sample was taken from the wheat flour reception, while the second sample was taken from the final product. All

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DOI: 10.21608/jfds.2020.160389

sampling technique was conducted in accordance with (Egyptian standard 7109, 2012).

Methods:

Hygienic samples (surface and hand swabs):

Sampling of swabs from working surfaces and hands of workers in the pasta processing line were conducted in accordance with (ISO 18593, 2018).

Implementation of food safety management system (FSMS):

Applications of food safety management system (FSMS) were conducted in accordance with (ISO 22000, 2018).

Prerequisite programs (PRP) definition:

Basic conditions and activities that are necessary within the organization and throughout the food chain to maintain food safety which is suitable for production, handling and provision of safe end products and safe food for human consumption. The prerequisite programs (PRPs) representing the conditions and/or the necessary basic activities to develop a generic FSMS model during pasta industry was evaluated according to (ISO/TS 22002-1, 2009).

Flow chart of pasta processing line was constructed in order to provide a clear, simple description of the steps involved in the process. It is a more detailed process the flow chart is included in Fig (1).

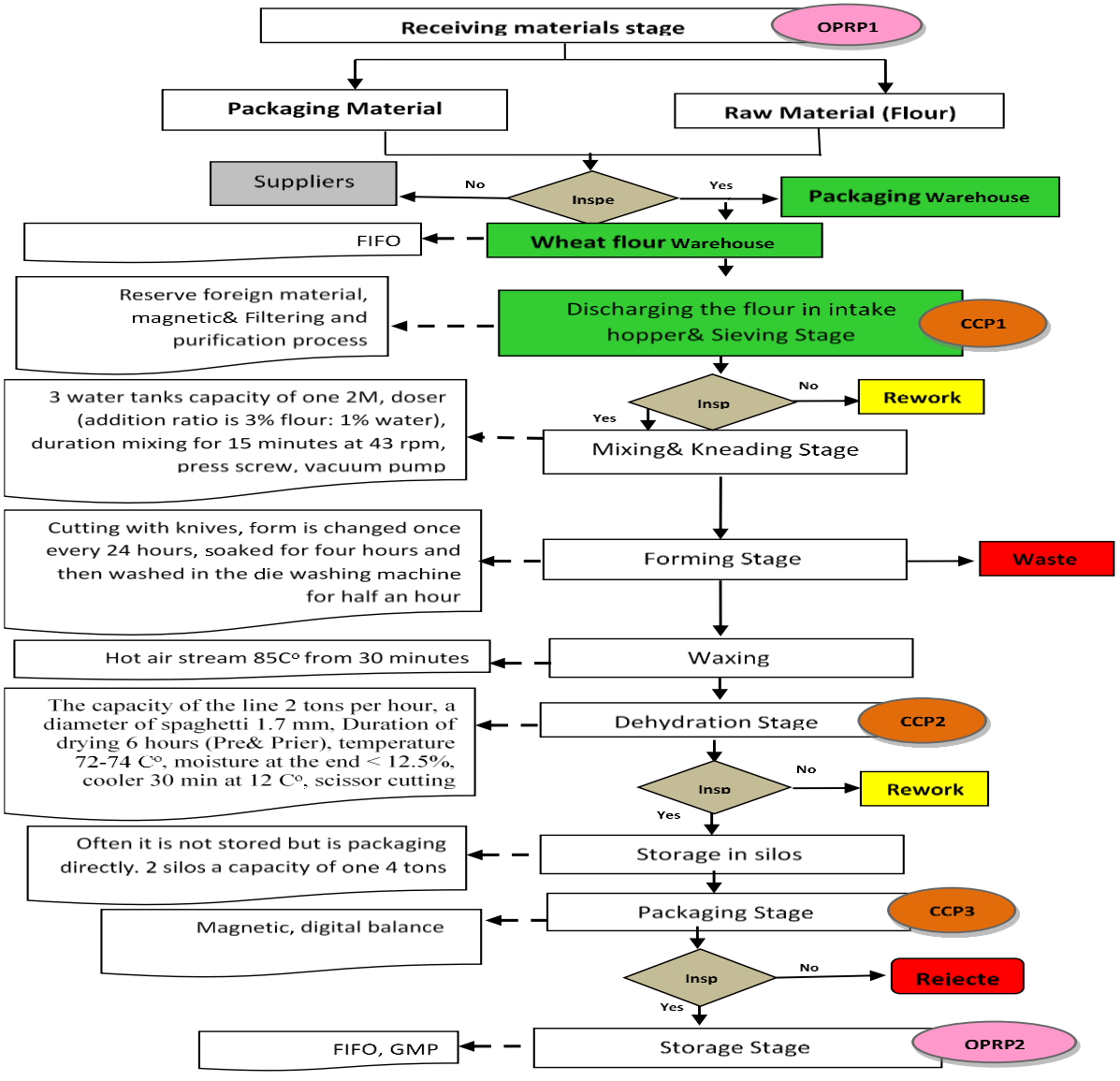

Fig. 1. Flow Chart of pasta process

Hazard assessment tools:

Hazard assessment as a tool to identify the hazard and its control measure was conducted risk management and communication. Decision tree a series of questions that are applied to each step in the process in respect of an identified hazard to identify which steps are CCPs or OPRPs according to (FSSC 22000, 2019).

Color determination of pasta:

Chroma Meter CR-410 (Konica Minolta, sensing Inc., Japan) was used to measure the color parameters like

brightness value L* (black (0) to white (100)), redness value a* (green (−) to red (+)) and yellowness value b* (blue (−) to yellow (+)) on the spaghetti according to the method described in (AACC, 2012).

Physicochemical characters:

Wet, dry and index gluten:

Wet, dry gluten and gluten index contents of both wheat flours (72% extraction) were determined using glutomatic apparatus according to the method described in (AACC, 2012).

Falling number (FN):

Falling No. values of wheat flours under study were determined according to the method described in (AACC, 2012).

Chemical analysis:

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

Heavy metals:

As, Pb, Sb, Cd and Zn were determined using the atomic absorption spectrophotometer (VARIAN, model AA240 FS, Australia) as described in (AOAC, 2016).

Swab testing techniques:

Test was performed in accordance with (ISO 18593, 2018). The swabs have been individually wrapped and sterilized.

Cooking quality of pasta:

The cooking methods for determined the quality of pasta samples were described by (AACC, 2012). Ten grams of spaghetti was placed into 300 ml of boiling water in a 500-ml beaker for seven min. After cooking, measurements were taken on the pasta as follows:

Optimum cooking time (min): for each sample under this study was determined according to (AACC, 2012). The spaghetti was considered cooked until observed white core had disappeared after the spaghetti was pressed between two Plexiglass plates.

The weight increase and Volume increase (swelling) % were calculated according to (Walsh and Gilles, 1971).

Total soluble solids (T.S.S %) or cooking loss: percent was measured by evaporating the spaghetti cooking water to dryness in oven at 100 °C as expressed by (AACC, 2012).

Texture analysis uncooked and cooked pasta:

Texture analyzer (Brookfield CT3 Texture Analyzer Operating Instructions Manual No. M08-372-C0113, Stable Micro Systems, USA) was used to measure the texture profile of spaghetti in term of hardness Newton's (N), According to (AACC, 2012).

Sensory evaluation of pasta:

Sensory properties of Spaghetti products were evaluated using experienced panelists from the staff of the Research sector, North Cairo Flour Mills and bakeries company, Egypt. Appearance (4), color (4), flavor (4), tenderness (5), stickiness (3) and total score (20) of cooked spaghetti were evaluated organoleptically according to (AL-Sayed *et al*., 2019). The cooked samples were evaluated for their sensory characteristics by 15 members.

Statistical analysis:

The statistical analysis was carried out using ANOVA with one factor under significance level of 0.05 for the whole results using SPSS (ver. 20). Data were treated as a complete randomization design according to (Steel *et al*., 1997). Multiple comparisons were carried out applying LSD.

RESULTS AND DISCUSSION

The food safety team:

The food safety team and the food safety team leader has been appointed by top management. A multidisciplinary team was created in the company to implement the (ISO 22000, 2018) standard. The team was committed to the study, development, establishment and review of all problems concerning the safety and management of spaghetti product. Indeed, the members are well-acquainted with the finished products, the used raw materials, supply specificities, production methods and all related problems. Accordingly, the following steps are followed to implementation ISO 22000:

Firstly: Create prerequisite programs PRPs:

Established the prerequisite programs in the pasta processing line before application of FSMS, were determined using specific criteria according to (ISO/TS 22002-1, 2009). All prerequisite programs were discussed after the conformity and non-conformity were identified with management to provide the required resources. The food safety team implemented and followed up all the observations. The result was that there were more notes, such as:

1. The factory's infrastructure was suitable for production food.
2. The location of the equipments allows access for operation, cleaning and maintenance.
3. An adequate number of toilets and appropriate facilities for washing and drying were provided.
4. A laboratory already found to determine physical and chemical properties.
5. The material received which impact food safety is already conformance to the specified.
6. The suitable space between materials and walls to allow for inspection and pest control activities in the storage.
7. Containers for waste be clearly identified, located in a designated area, cleaned, closed when not in immediate use.
8. Cross-contamination between the raw materials are actually separated from the finished products.
9. The food safety team has been trained on the requirements of ISO 22000.

Secondly: Describe the product and its intended use:

The spaghetti is a product of wheat flour extracted 72% and it is flour free from foreign odors or any odors indicating corruption and the moisture content not more than is 14% for the flour. Pasta is the drying forms of dough made from adding water to wheat flour 72% extract. Pasta from dry food products its moisture content is not more than 12.5% and it is packaged in sacks or bags made from polypropylene weighing 350 g, 400 g, 500 g, 10 and 20 kg shown in Table (1). Stored in a place with good ventilation and a temperature suitable for dry storage and pasta is susceptible to pest infestation if stored for long periods of time, and its shelf life is 18 month from the date of production, the purpose of the use of nutrition for all age groups according to (Varzakas, 2016 and Xiaowei *et al*., 2016).

Table 1. Pasta description and its intended use.

Product name	Pasta
Product characteristics	Pasta drying forms of dough made from adding water to wheat flour 72% Extract.
Intended use	Nutrition for all age groups.
Packaging requirement	Handle in plastic bags made from polypropylene
Packaging	Packages 350& 400& 500 gm and 10& 20 Kg
Distribution	By company vehicles or customer vehicles
Shelf life	(18 Months)
Where the product will be sold	Supermarkets
Storage conditions	No physical damage, excess humidity or temperature extremes
Labeling instructions	Required to ensure product safety, e.g. date of product, net weight, pasta type, cooking instructions, trade mark, Shift.

Thirdly: Conduct a hazard analysis and identification:

The hazards were analyzed for all stages of processes, according to which critical limits and checkpoints criteria were identified for the different stages shown in Table (2) according to (Varzakas, 2016 and Xiaowei *et al.*, 2016). Receiving material stage its checkpoints are as follows, foreign matter and insects in wheat flour should be absent from the sample.

Discharging the flour in intake hopper and sieving stage its critical limits foreign matter, metals and insects should be absent from the sample.

Mixing and kneading stage its checkpoints are as follows, the falling number should be >300 from the sample. Foreign matter and metals should be absent.

Forming stage the checkpoints were insects should be absent as well as foreign matter and metals from the sample.

Dehydration stage the critical limits were absent from microbial activity of the sample. In order to achieve this, the temperature must be controlled from 72 to 74 ºC, relative humidity is from 74 to 76% and moisture of end product is less than 12.5%.

Packaging stage the critical limits were given as follows packaging material should free from insects and foreign matter. Heavy metals of packing material for printing ink from the sample that represents for lead (Pb) should be <0.5 ppm.

Storage stage the product this as the endpoint of monitoring the checkpoints include was the absence from insects and foreign matter and metals.

Table 2. Hazard identification for pasta processing steps.

Processing steps	Hazard type	Hazards	Control measures	Critical limits or Check point	Monitoring frequency
Wheat flour reception	P	Foreign material and metals	Lab inspection	Absent	Per lot
	C	-	-	-	
	B	insects	Lab test	Absent	
Discharging the flour in intake hopper& sieving	P	Foreign material and metals	Lab inspection	Absent	Daily check
	C	-	-	-	
	B	insects	Lab inspection	Absent	
Mixing and kneading	P	Foreign material and metals	Lab inspection	Absent	Daily check
	C	Presence of activity of alpha-amylase enzyme	Lab test	Falling number >300	
	B	-	-	-	
Formation	P	Foreign material and metals	Lab inspection	Absent	Daily check
	C	-	-	-	
	B	insects	Lab inspection	Absent	
Dehydration	P	Temperature, Relative humidity, Moisture of end product	Inspection	From 72 to 74 ºC From 74 to 76% < 12.5%	Daily check
	C	-	-	-	
	B	Microbial activity	Control of temperature, Relative humidity and moisture	Absent	
Packaging	P	Foreign material and metals	Lab inspection	Absent	Daily check
	C	Heavy metals of packing material (Pb)	Lab test	<0.5 ppm	
	B	Insects	Lab inspection	Absent	
Storage the product	P	Foreign material and metals	Lab inspection	Absent	Monthly
	C	-	-	-	
	B	Insects	Lab inspection	Absent	

P: physical, C: chemical, B: biology hazard

Fourthly: Control of critical control points and operational prerequisite programs (CCPs& OPRPs):

The food safety team established critical limits or monitoring systems for each critical control point and operational prerequisite programs to demonstrate that the CCPs and OPRPs are under control and recorded as seen in Table (3) and (4) according to (Varzakas, 2016 and Xiaowei *et al.*, 2016).

Discharging the flour in intake hopper and sieving stage the CCP1. It is any foreign material and metals that should be absent on a sieve of 60 microns, and a record has been made to follow up on the sieve every shift by the quality responsible.

Dehydration stage the CCP2 the quality responsible becomes responsible for visual inspection and lab test of temperature should be from 72 to 74 ºC, relative humidity is from 74 to 76% and the moisture of end product must be < 12.5% every shift.

Packing stage it's CCP3. Quality responsible becomes responsible for visual inspection of metal detectors to remove foreign matter and metals.

Receiving material stage needs monitoring program because foreign materials and metals found in these wheat flour are also, potential health risks for consuming. Otherwise, other ingredients like packaging material, disinfection and sanitizers should be supplemented with its material safety data sheets (MSDS). These operations need operational pre-requisite program and are registered as OPRP1, this is followed up periodically by the quality responsible.

Storage of product stage it was found during the study, that those step need monitoring program so are registered as the operational prerequisite program OPRP2. It is to be committed to storage in dry and ventilated warehouses free of insects and rodents, this is followed up periodically by the quality responsible.

Table 3. Hazard control plan of CCP for the process of pasta.

CCP	Hazards	Critical limits	Devices used for monitoring	Verification	Records& responsibilities
CCP1 Discharging the flour in intake hopper& sieving	Physical (Foreign material and metals)	Nothing impurities on a sieve of 60 microns	Control sieve, Metal detector before next step.	Testing HACCP plan review	Record of follow up ccp1 (Quality responsible)
CCP2 Dehydration	Biological (microbial activity is caused by low temperatures and high humidity)	Temperature from 72 to 74 ºC & Relative humidity from 74 to 76%& Moisture of end product is 12.5%	Control of temperature, moisture and Relative humidity during drying.	Testing HACCP plan review	Record of follow up ccp2 (Quality responsible)
CCP3 Packing	Physical (Foreign material and metals)	Absent	Metal detector before packing.	Testing HACCP plan review	Record of follow up ccp3 (Quality responsible)

Table 4. Hazard control plan of OPRP for the process of pasta.

OPRP	Hazards	Checkpoint	Verification	Records& responsibilities
OPRP1 receiving material	Wheat Flour: Physical (Foreign material and metals) Packaging material: Chemical (Heavy metals from printing ink)	Monitoring program for receiving.	Monitoring program review MSDS review	Record of examination and receipt (Quality responsible)
OPRP2 Storage of product	Physical: Foreign material and metals Biology: insect	Monitoring program for storage	Monitoring program review	Record of follow up the product (Quality responsible)

Fifthly: Establish a corrective action plan:

The need for corrective actions is evaluated when critical limits at CCPs and/or action criteria for OPRPs are not met. The factory establishes and maintains documented information that specifies appropriate actions to identify and eliminate the cause of detected nonconformities, to prevent a recurrence, and to return the process to control after a nonconformity is identified according to (Varzakas, 2016).

Sixthly: Verification of effectively implementing the HACCP plan and operational prerequisite programs:

The food safety team has created a PRPs verification plan and a risk control plan to ensure that all food safety management system operations are effectively implemented and updated. The verification plan should include checking the steps of the HACCP, the calibration of devices, the results of the tests, the state of the sieves and the efficiency of the magnet. Therefore, an internal audit is conducted on the system as a whole in an impartial, independent manner and sequential according to the internal audit plan by the food safety team to verify the effectiveness of the system.

Seventhly: Documented information:

Creating and updating documented information of the food safety management system for all operations. These records should be kept for at least a year after the shelf life of the product.

Eighthly: The tests that were taken to ensure the safety of the operations:

The required measurements were determined from the beginning of the receiving materials through all stages until the final product is delivered to the customer by the following:

1.Color determination of uncooked and cooked pasta:

The color was measured before and after cooking, for pasta made from Russian wheat flour extracted 72% at three times (zero time, after one and two months) the results are shown in Table (5). The results showed that the color of spaghetti before and after cooking recorded the highest value for it in the after one month for all values except the a-value after cooking. On the other hand, it is noticed that the value of the L-value increased after the cooking in color white in all stages, in contrast to the values of a-value and b-value, the red and yellow color as they recorded lower results after cooking. These results are nearly agreement with those reported by (Wood, 2009; Hussein et al., 2010; Kamil et al., 2011; Yaseen and Shouk, 2011 and Wójtowicz et al., 2020).

Table 5. Color parameters of Pasta.

Components	Uncooked pasta			Cooked pasta		
Storage period per month	(L- value)*	(a- value)*	(b- value)*	(L- value)*	(a- value)*	(b- value)*
Zero time	41.87	2.59	17.11	61.37	1.19	16.47
One month	56.4	4.12	24.5	82.59	1.07	21.74
Two month	40.90	3.99	16.69	59.26	0.89	15.70

L* Value Whiteness 100 White / 0 Black
a* Value Positive Values (+) Red Color / Negative Values (–) Green Color
b* Value Positive Values (+) Yellow Color / Negative Values (–) Blue Color

2.Physiochemical properties of wheat flour:

The gluten and falling number of Russian wheat flour (72% extraction) are shown in Table (6). A wet gluten test was performed the results were 24.2, dry gluten 8.0, gluten index 98.8 was recorded. These results are in agreement with those obtained by (Ali, 2012; Salehifar *et al.*, 2012; Bueno *et al*., 2016 and Liu *et al.*, 2017). The falling number was 380 seconds. These results are in agreement with those obtained by (Gomes *et al*., 2012 and Liu *et al.*, 2017).

Table 6. Physiochemical properties of wheat flour (72% ext.) to use of pasta processing line:

Components Sample	Wet gluten content (%)	Dry gluten content (%)	Gluten Index (%)	Falling. No (Sec)
Wheat flour	24.2	8.0	98.8	380

3.Chemical composition of wheat flour and pasta:

Chemical composition of wheat flour:

Chemical composition of Russian wheat flour (72% extraction) was presented in Tables (7). The results showing moisture, protein, fat, ash, and total carbohydrates were as follows: 13.13, 11.59, 1.65, 0.43 and 73.20%, respectively. These results are in agreement with those obtained by (Mepba *et al.*, 2007; Kamil *et al*., 2011 and Wójtowicz *et al*., 2020).

Table 7. Chemical composition of wheat flour (72%ext.) (g/100g on wet weight basis).

Components Sample %	Moisture	Protein	Fat	Ash	Total carbohydrate
Wheat flour	13.13	11.59	1.65	0.43	73.20

Chemical composition of pasta:

Chemical composition of pasta were presented in Tables (8). The results for pasta showed that the moisture content decreased significantly from 11.93 at zero time to 11.23% after two months of storage. These data are similar with those reported by (Martinez *et al*., 2007; Panghal *et al*., 2019 and Teterycz *et al*., 2020). The protein content ranged from 12.27 to 12.34%. These data are in agreement with those indicated by (Wood, 2009; Sule *et al*., 2019 and Teterycz *et al*., 2020). While the fat content were 0.84% for all samples. The results generally showed that there were no significant differences ($p < 0.05$) both the protein and fat content values at the different samples. The obtained data are in line with those obtained by (Sobota *et al*., 2013 and Wójtowicz *et al*., 2020). Ash values ranged from 0.52 to 0.55% which was significantly higher after two months, while it was significantly lower after one months. These data are agreement with those indicated by (Panghal *et al*., 2019; Teterycz *et al*., 2020 and Wójtowicz *et al*., 2020). Moreover, the percentage of total carbohydrates increased significantly from 74.42 at zero time to 75.09% after two months of storage. These results are agreement with (Sule *et al*., 2019 and Panghal *et al*., 2019).

Table 8. Chemical composition of pasta (mean±SE) (g/100g on wet weight basis).

Storage period per month	Components %				
	Moisture	Protein	Fat	Ash	Total carbohydrate
Zero time	11.93±0.03^{a}	12.27±0.03^{a}	0.84±0.02^{a}	0.53±0.00^{ab}	74.42±0.03^{c}
One month	11.67±0.03^{b}	12.34±0.03^{a}	0.84±0.03^{a}	0.52±0.01^{b}	74.63±0.05^{b}
Two month	11.23±0.03^{c}	12.28±0.02^{a}	0.84±0.02^{a}	0.55±0.01^{a}	75.09±0.06^{a}
LSD 0.05	0.00	0.22	0.99	0.03	0.00

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter.

The protein content ranged from 12.27 to 12.34%. These data are in agreement with those indicated by (Wood, 2009; Sule et al., 2019 and Teterycz et al., 2020). While the fat content were 0.84% for all samples. The results generally showed that there were no significant differences ($p < 0.05$) both the protein and fat content values at the different samples. The obtained data are in line with those obtained by (Sobota et al., 2013 and Wójtowicz et al., 2020). Ash values ranged from 0.52 to 0.55% which was significantly higher after two months, while it was significantly lower after one months. These data are agreement with those indicated by (Panghal et al., 2019; Teterycz et al., 2020 and Wójtowicz et al., 2020). Moreover, the percentage of total carbohydrates increased significantly from 74.42 at zero time to 75.09% after two months of storage. These results are agreement with (Sule et al., 2019 and Panghal et al., 2019).

4.Heavy metal concentration of packaging material to use in packing pasta:

Heavy metal contents (Arsines, lead, Antimony, cadmium and zinc) of packaging material to use in packing pasta were presented in Table (9). The obtained data revealed that the heavy metal contents of packaging material were 0.05, 0.04, 0.03, 0.004 and 0.002 ppm for Arsines, lead, Antimony, cadmium and zinc, respectively. The results are in agreement with the accepted limit according to (Egyptian standard 6050, 2007).

Table 9. Heavy metal concentration of packaging material to use in packing pasta (ppm).

Items	Results
As*	0.05
Pb*	0.04
Sb*	0.03
Cd*	0.004
Zn*	0.002

***As=Arsines, Pb= lead, Sb=Antimony, Cd=cadmium, Zn=zinc**

5.Microbiological analysis of swabs from workers and surfaces in pasta processing line:

Swabs from workers who are in contact with the product were conducted and the results were given in Table (10). Hand swabs from workers of processing line (packaging) were tested for enumeration of microoraganisms, enumeration of enterobacteriaceae and enumeration of coagulase-positive staphylococci. According to the result, it could be noticed that, enumeration of microoraganisms of swabs from hands of plant workers was 7.4×10^{3} and 1.8×10^{3} log cfu/swab, respectively, during the investigation period. In the same time, enumeration of enterobacteriaceae was 1.2×10^{2} and 60 log cfu/swab, respectively. Otherwise, enumeration of coagulase-positive

staphylococci was 7.6×10^2 and <10 log cfu/swab, respectively during the investigation period. The aforementioned parameters were chosen as microbiological criteria for the evaluation of personal hygiene as listed in many studies (Sperber, 2007 and El-Bayoumi *et al.*, 2013).

Table 10.Microbiological analysis of swabs from workers is in touch with the product and swabs from surfaces in pasta processing line.

Samples	Swabs from workers (log cfu/swab)		
	Enumeration of microoraganisms 30ºC	Enumeration of Enterobacteriaceae	Enumeration of Coagulase-positive Staphylococci
Workers	7.4×10^3	1.2×10^2	7.6×10^2
	1.8×10^3	60	< 10
Swabs from machines (log cfu/swab)			
Machines	1.9×10^2	< 10	< 10
	70	< 10	< 10
	40	< 10	< 10
	1.8×10^2	< 10	< 10

Swabs from surfaces (25 cm2), machines which in contact with the product during the investigation period, were conducted and the results are described in Table (10). Surfaces swabs from machines, which are in contact with the product during the investigation period were tested for enumeration of microoraganisms, enumeration of enterobacteriaceae and enumeration of coagulase-positive staphylococci. Following results, it could be noticed that enumeration of microoraganisms of swabs from surfaces of machines was 1.9×102, 70, 40 and 1.8×102 log cfu/ swab, respectively during the investigation period. On the other side, enumeration of enterobacteriaceae and enumeration of coagulase-positive staphylococci were < 10 log cfu / swab during the investigation period. The aforementioned parameters were chosen as microbiological criteria for the evaluation of good hygiene practices (GHP) as listed in many studies such as (Ismaïl et al., 2013 and Lahou and Uyttendaele, 2014).

6.Cooking quality properties of pasta:

The results are shown in Table (11) that there were no significant difference between spaghetti samples in volume of 100g uncooked spaghetti (cm3), optimal cooking time (min), Volume of 100g cooked pasta (cm3) and Volume increase (swelling) %. While there were significant difference (P > 0.05) between spaghetti samples in weight increase % and cooking loss % (Total soluble solids (T.S.S)). Results indicated that the highest of cooking loss % (8.21%) followed by (7.89%) for zero time and after one month, respectively. Optimal cooking time that 7 min in the amount of time required to optimally cooking all spaghetti samples. This results are in consistence with (Wood, 2009; Hussein et al., 2010; Kamil et al., 2011; Yaseen and Shouk, 2011; Sobota et al., 2013; Padalino et al., 2019 and Wójtowicz et al., 2020).

Table 11. Cooking quality properties of pasta prepared from wheat flour (72%ext.) (mean±SE).

Components Storage period per month	Volume of 100g uncooked pasta (cm^3)	Optimal cooking time (min)	Volume of 100g cooked pasta (cm^3)	Volume increase (swelling) (%)	Weigh increase (%)	Cooking loss (%)
Zero time	70.00±0.00^a	7.00±0.00^a	200.00±0.00^a	185.71±0.00^a	137.33±1.13^b	8.21±0.02^a
One month	70.00±0.00^a	7.00±0.00^a	210.00±0.00^a	200.00±0.00^a	142.47±0.55^a	7.89±0.02^b
Two month	70.00±0.00^a	7.00±0.00^a	200.00±0.00^a	185.71±0.00^a	140.57±1.16^{ab}	7.58±0.14^c
LSD 0.05	--	--	--	--	0.03	0.00

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter.

7.Texture analysis of pasta:

The breaking force uncooked and the cutting force cooked were estimated for pasta made with Russian wheat flour extracted 72% shown in Table (12).

Table 12. Texture analysis of pasta prepared from wheat flour (72%ext.).

Storage period per month	Breaking force (N*)	Cutting force (N*) Cooked pasta	
	Uncooked pasta	After 7 min	After 14 min
Zero time	65.69	5.08	4.51
One month	79.16	5.41	4.11
Two month	47.13	6.55	4.11

*** Newton**

The results showed that spaghetti uncooked needed more force and recorded its highest value in after one month and was 79.16 (N.). On the other hand, cooked pasta needed less force and had a maximum value recorded in after two month, which was 6.55 (N.). These results were obtained with (Wood, 2009; Padalino *et al*., 2019 and Wójtowicz *et al*., 2020).

8.Sensory evaluation of pasta:

Sensory evaluation of pasta made with Russian wheat flour extracted 72% through appearance, color, flavor, tenderness, stickiness, and total score as presented in Table (13).

Table 13. Sensory evaluation of pasta prepared from wheat flour (72%ext.) (mean±SE).

Storage period per month	Appearance (4)	Color(4)	Flavor(4)	Tenderness (5)	Stickiness (3)	Total score (20)
Zero time	3.67±0.13^a	3.13±0.13^a	3.40±0.13^a	3.63±0.17^a	2.50±0.13^a	16.33±0.45^a
One month	3.27±0.12^b	2.93±0.12^a	3.07±0.07^a	3.83±0.15^a	2.33±0.13^a	15.43±0.29^a
Two month	3.07±0.12^b	3.00±0.10^a	3.07±0.15^a	3.93±0.15^a	2.60±0.13^a	15.67±0.44^a
LSD 0.05	0.00	0.48	0.10	0.41	0.34	0.27

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter.

The results showed that there were no significant difference (P < 0.05) in the color, flavor, tenderness, stickiness and total score of all pasta samples. While there is significant difference in the appearance only of all pasta samples. On the other hand, the total scores of sensory characteristics recorded the highest value for it zero time, which was 16.33. Similar results were obtained by (Hussein et al., 2010; Kamil et al., 2011; Yaseen and Shouk, 2011 and AL-Sayed et al., 2019).

CONCLUSION

The importance of ISO 22000 is evident in monitoring food factories until the provision of a safe product to the consumer. This must be checked periodically. In this investigation, the level of workers in the factory was

raised with training on some courses in food safety, and the results found that there are critical control points in some processing steps and with training theoretically and practically these points were controlled.

REFERENCES

A.A.C.C. (2012). Approved Method of American Association of Cereal Chemists, published by American Association of Cereal Chemists, Ins. St. Paul, Minnesota, USA.

A.O.A.C. (2016). Association of Official Analytical Chemists' Official methods of Analysis of AOAC. International 18thed. Published by AOAC International Maryland, USA.

Ali, W.M. (2012). Studies on used some emulsifiers to improvement the quality of some bakery products. M.Sc. Thesis, Fac. of Agric., Benha Univ., Egypt.

AL-Sayed, H.M.; Zidan, N.S. and Abdelaleem, M.A. (2019). Utilization of Garden Cress Seeds (*Lepidium sativum L.*) as Natural Source of Protein and Dietary Fiber in Noodles. J. of Pharmaceutical Research & Allied Sciences, 8 (3): 17-28.

Bueno, M.M.; Thys, R.C.S. and Rodrigues, R.C. (2016). Microbial enzymes as substitutes of chemical additives in baking wheat flour-part II: combined effects of nine enzymes on dough rheology. J. Food and Bioprocess Technology, 9 (9): 1598-1611.

Chen, H.; Liu, S.; Chen, Y.; Chen, C.; Yang, H. and Chen, Y. (2019). Food safety management systems based on ISO 22000:2018 methodology of hazard analysis compared to ISO 22000:2005. J. Accreditation and Quality Assurance, 1–15.

Egyptian standard 6050 (2007). E.S, General requirements for packages and wrapping used in food products.

Egyptian standard 7109 (2012). E.S, Wheat flour with its extraction and method of analysis and testing, Methods of analysis and testing- sampling.

El-Bayoumi, M.M.; Heikal, Y.A.; Salwa, M.A. and Abdel-Razik, M.M. (2013). Implementation of ISO 22000 as a Food Safety Management Tools in Wheat Milling Industry. J. of Dairy & Food Sciences, 8 (1): 27-37.

Food Safety System Certification, FSSC 22000 (2019). Guidance document: ISO 22000:2018. Interpretation.

Gomes-Ruffi, C.R.; da-Cunha, R.H.; Almeida, E.L.; Chang, Y.K. and Steel, C.J. (2012). Effect of the emulsifier sodium stearoyl lactylate and of the enzyme maltogenic amylase on the quality of pan bread during storage. J. Food Science and Technology, 49 (1): 96-101.

Hussein, A.M.; Kamil, M.M. and Ragab, G.H. (2010). Technological Properties of some Egyptian New Wheat Varieties. J of American Science, 6 (10): 1160-1171.

International Standards Organization (2009). ISO/TS 22002-1. Prerequisite programmes on food safety, Part 1: Food manufacturing.

International Standards Organization (2018). ISO 18593 Microbiology of food and animal feeding stuffs, Horizontal methods for sampling techniques from surfaces using contact plates and swabs.

International Standards Organization (2018). ISO 22000. Food safety management systems - Requirements for any organization in the food chain.

Ismaïl, R.; Aviat, F.; Michel, V.; Bayon, I.; Gay-Perret, P.; Kutnik, M. and Fédérighi, M. (2013). Methods for Recovering Microorganisms from Solid Surfaces Used in the Food Industry: A Review of the Literature. J. Environ. Res. Public Health, 10: 6169-6183.

Kamil, M.M.; Hussien, A.M.; Ragab, G.R. and Khalil, S.K. (2011). Detecting Adulteration of Durum Wheat Pasta by FT-IR Spectroscopy. J of American Science, 7 (6):573-578.

Lahou, E. and Uyttendaele, M. (2014). Evaluation of Three Swabbing Devices for Detection of *Listeria monocytogenes* on Different Types of Food Contact Surfaces. J. Environ. Res. Public Health, 11: 804-814.

Liu, T.; Hou, G.G.; Cardin, M.; Marquart, L. and Dubat, A. (2017). Quality attributes of whole wheat flour tortillas with sprouted whole-wheat flour substitution. J. Food Science and Technology, 77: 1-7.

Martinez, C.S.; Ribotta, P.D.; Leon, A.E. and Anon, M.C. (2007). Physical, sensory and chemical evaluation of cooked spaghetti. J. Texture Stud., 38: 666-683.

Mepba, H.D.; Eboh, L. and Nwaojigwa, S.U. (2007). Chemical composition, functional and baking properties of wheat-plantain composite flour. J. Food Agric. Nutr. Development, 7 (1): 1-22.

Padalino, L.; Nobile, M.A.D.; Gatta, B.L.; Rutigliano, M.; Luccia, A.D. and Conte, A. (2019). Effects of microwave treatment of durum wheat kernels on quality characteristics of flour and pasta. J. Food Chemistry, 283: 454-461.

Panghal, A.; Kaur, R.; Janghu, S.; Sharma, P.; Chhikara, N. and Sharma, P. (2019). Nutritional, phytochemical, functional and sensorial attributes of *Syzygium cumini L.* pulp incorporated pasta. J. Food Chemistry, 289: 723–728.

Salehifar, M.; Adili, L.; Tarzi, B.G. and Bakhoda, H. (2012). Effects of lipase, phospholipase and DATEM on some quality characteristics of bugget. J. Ann. Biol. Res., 3: 5236-5241.

Simonato, B.; Curioni, A. and Pasini, G. (2015). Digestibility of pasta made with three wheat types: A preliminary study. J. Food Chemistry, 174: 219-225.

Sobota, A; Zarzycki, P.; Rzedzicki, Z.; Sykut-Domanska, E. and Wirkijowska, A. (2013). Effect of cooking time on the texture and cooking quality of spaghetti. J. Acta Agrophysica, 20 (4): 693-703.

Sperber, W.H. (2007). Role of microbiological guidelines in production and commercial use of milled cereal grains: A practical approach for the 21st century. Journal of Food Production, 70 (4): 1041:1053.

Steel, R.; Torrie, J. and Dickey, D. (1997): Principles and procedures of Statistics: A Biometrical Approach, 3rd ed., McGraw-Hill, New York, USA.

Sule, S.; Oneh, A.J. and Agba, L.M. (2019). Effect of carrot powder incorporation on the quality of pasta. Food Processing & Technology, 7 (3): 99-103.

Teterycz, D.; Sobota, A.; Zarzycki, P. and Latoch, A. (2020). Legume flour as a natural colouring component in pasta production. J. Food Sci Technol, 57: 301-309.

Varzakas, T. (2016). HACCP and ISO22000: Risk Assessment in Conjunction with Other Food Safety Tools Such as FMEA, Ishikawa Diagrams and Pareto. J. Encyclopedia of Food and Health, 295-302.

Walsh, D.E. and Gilles, K.A. (1971). The influence of protein composition on spaghetti quality. J. Cereal Chem, 48: 544-554.

Wójtowicz, A.; Oniszczuk, A.; Kasprzak, K.; Olech, M.; Oniszczuk, T. and Mitrus, M. (2020). Chemical composition and selected quality characteristics of new types of precooked wheat and spelt pasta products. J. Food Chemistry. Article in press.

Wood, J.A. (2009). Texture, processing and organoleptic properties of chickpea-fortified spaghetti with insights to the underlying mechanisms of traditional durum pasta quality. J. of Cereal Science, 49: 128–133.

Xiaowei, F.; Huang Bin, H. and Wenping, Y. (2016). Using HACCP to Control Hazards in Fresh Noodles Processing Line. J. Food Sci. Technol., 10 (10): 721-725.

Yaseen, A. and Shouk, A. (2011). Low phenylalanine pasta. J. of Nutrition and Metabolism, 3 (10): 128-135.

تطبيق نظام ايزو ٢٢٠٠٠ في تصنيع الأسباجتي

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تم تطبيق نظام ادارة سلامة الغذاء ايزو 22000 علي صناعة الأسباجتي لتعزيز سلامة الأغذية، حماية المستهلك، تعزيز ثقة المستهلك وتحسين كفاءة التكلفة. تمت هذة التجربة في شركة مطاحن ومخابز شمال القاهرة- مصنع المكرونة- شبرا الخيمة- القاهرة- مصر. تم متابعة جميع المراحل بداية من استلام المواد الخام الي ان يتم انتاج المكرونة الأسباجتي وتخزينها وكانت النتائج كالأتي بدايتاً بتعيين الأدارة العليا فريق سلامة الغذاء وان البنية التحتية مناسبة للعملية الإنتاجية وتم وصف منتج المكرونة الأسباجتي وتم عمل رسم تخطيطي لعملية الصناعة وتم تحليل وتقييم المخاطر وتم تحديد مرحلة النخل ومرحلة التجفيف ومرحلة التعبئة انهما نقاط تحكم حرجة (CCPs) وتم تحديد مرحلة استلام الخامات ومرحلة تخزين المنتج انهما برامج تحضيرية للتشغيل (OPRPs) ويتم التحقق من فاعلية تطبيق خطة الهاسب. التحليل الميكروبيولوجي لمسحات العمال والأسطح في الحدود المسموح بها. اظهرت النتائج عدم وجود فروق معنوية بين التركيب الكيميائي للأسباجتي. كانت نسبة العناصر الثقيلة لمواد التعبئة والتغليف المستخدمة في تعبئة الأسباجتي في الحدود المسموح بها.

الكلمات الدالة: ايزو ٢٢٠٠٠- سلامة الغذاء- الهاسب- سباجتي.