EVALUATION OF HYGIENIC QUALITY OF BURGER IN TWO PROCESSING PLANTS IN ALEXANDRIA PROVINCE

Wafaa M. M. Eissa and Nabila F. Soliman

Animal Health Research Institute, Alexandria Provincial Lab,

Food Hygiene Research Unit

ABSTRACT

The evaluation of hygienic quality of burger (frozen meat product) in two parallel flows processing of meat products in Alexandria province. One flow of meat produced according to the new safety assurance, superior system will exist plant (A). The other flow will consist of meat produced and inspected in the traditional way. This study was done through bacteriological examination of meat, product and contact surroundings (swabs of workers, walls and machines). Bacteriological examination of samples included total bacterial count, besides isolation of Staphylococcus aureus and Salmonellae of both frozen raw meat and finished burger products. Monitoring system that keeps track of the important health hazards in the entire chain from raw meat till ready to eat meat. Results revealed that the bacteriological quality of raw meat in both plants within the acceptable limit but it is slightly exceed in plant (B) and presence of Staphylococci. Bacteriological results of final burger products samples in plant (A) within the legal limit of APC, while in plant B most samples reach the top of acceptable limit of APC and S. aureus isolated from 70% of samples. Salmonellae could not be detected in all examined samples. Results of swabs from food contact surroundings indicated that plant (A) was lower than plant (B) in APC of swabs of workers, walls and machines. The whole system of plant (B) is conductive to microbiological growth. Our results of final burger product samples of APC after grill of both plants were good depending the time and method of cooking. Some recommendations have been formulated at the industry's level, at the institutional level and hygienic requirements needed to produce safe and good quality burger in both plants were discussed to by implemented.

INTRODUCTION

In recent decades, the increase of human population in relation to the great development in human life caused a great demand of easily prepared meals contained high level of animal protein. However, meat products are generally excellent sources of protein containing a good balance of the essential amino acids and having a high biological value. It is a good source of most B-complex vitamins and also contributes significant percentage of minerals including iron, copper, zinc, sodium, potassium and magnesium, which are essential for growth and health of human beings.

Technological development in meat processing and handling have given consumers a much greater choice over the food they can buy. So meat hygiene can comprise nearly every aspect of proeessing from the health of the live animal to the distribution of the final product. It prevents harmful ingredients manufactured meat products and the sale of contaminated or unwholesome meat.

The effects of hazards on human health assoeiated with food, the increasing importance and rapid growth of world food trade and the demand by consumers for a safe food supply make the analysis of the hazards (risks) assoeiated with food more important today than ever before.

The analysis and the development of organized programs to eliminate such hazards or control within aeeeptable limits those risks not possible to eliminate, have been designated as Hazard Analysis and Critical Control Point (HACCP) system.

Beef burgers are highly demanded due to their high biological value, reasonable price, agreed taste and ease of serving. It is considered as an excellent source of high quality protein.

Beef burgers are grind frozen formulated meat formed in constant circular shape, thickness and weight to be served to general public in high volume fast food operation in which frozen burgers are received, cooked and served in few minutes of eooking.

Beef burger as meat products are subjected to strict quality ehecks, to ensure that the products meet the agreed quality standards. These have to be right first time, every time, this quality control which involve inspection and testing at the end of the manufacturing proeess.

Proeessed meat products may at time constitutes a public health hazard due to presenee of spoilage microorganisms responsible for objectionable ehanges or pathogenie leading to infeetion and intoxication.

A polluted environment and lack sanitation increases the likelihood of a food contamination. In countries where food eontrol is weak beeause of lack of resources, edueation of consumers and food handlers in food safety gives them the knowledge to be selective when ehoosing food and to refuse food that is of doubtful hygienic quality **(WHO, 2000)**.

The quality of a product may be defined as its measurement against a standard regarded as excellent at a particular priee which is satisfactory both to the producer and to the consumer.

It has been claimed that the efficiency of microbiological control can be improved signifieantly by a logical and systematic stepwise analysis of the risks involved in any process.

Meat and meat products are liable to be contaminated with different types of microorganisms from different sources. Such eontamination may be of public health hazard to consumers or may render the products unmarketable especially in small factories. In which the hygienic measures are still underway. Therefore, one of the main responsibili-

ties of the meat technologists and scientists are to find the best possible way to produce a product free from pathogens of public health hazard and with low microbial contents in order to improve its quality. Heat treatment (grill) had a significant effect on bacteriological quality of the beef burger.

The Aim of this work was to investigation of the hygienic quality of beef burger in plant that applying quality assurance program as well as in a traditional plant, the importance of good manufacturing practices (GMP) and quality control in all stages of production of meat according to the principles of Hazard Analysis and Critical Control Points (HACCP) is advised.

MATERIAL AND METHODS

Collection of samples:

Preparation of samples

A total of three hundreds random samples were collected from two manufacturing plants. First plant (plant A), applying a new safety assurance, superior system during processing, while the second plant (plant B) contained a meat produced and inspected in the traditional way.

The collected samples were frozen raw meat (resembling 25 batches), final product and after grill (25 samples of each). The samples were thoroughly mixed and 25 g. were homogenized in 225 ml of 0.1% sterile peptone water in disposable sterile plastic bag in stomacher lab blender for 30 seconds to give a dilution of 1/10 then the decimal dilutions up to 10^{-5} were prepared. 1 ml from each dilution was transferred with the sterile 1 ml pipette to each two separate sterile petridishes. Colonies were counted and recorded as the total colony per gram of sample also swabs of workers, walls, machines (calculated colony/ cm^2) from each plant.

The samples were directly transferred to the laboratory in an insulated ice box under aseptic conditions without any delay for the following bacteriological examination.

a- Determination of total aerobic bacterial count according to the technique recommended by **APHA (1992)**.

b- Isolation and identification of Staphylococcus aureus was carried out according to **ICMSF (1996)**.

c- Detection of Salmonellae: according to **Vassilliadis et al. (1983)**.

Flow chart shows the unit operations in burger manufactures. Receiving and storage of raw meat → Deboxing of frozen meat → initial grind → batch formulation → meat blended in mixer/grinders → transfer to formers → forming → freezing tunnels → packing → frozen storage.

RESULTS

The data illustrated in table (1) revealed that the total aerobic plate counts (APC) of examined frozen raw meat in plant (A) ranged from 1.1x10 to 2.4×10^2 with a mean value of $5.5 \times 10 \pm 1.1 \times 10$, while in plant (B), were $1.3 \times 10 - 3.1 \times 10^2$ with a mean value of $6.28 \times 10 \pm 1.32 \times 10$.

T. test confirmed that there was no significant difference of APC in examined raw meat samples in both plants, Staphylococeus aureus could not be detected in plant (A), while in plant (B), each constituting 20%. Salmonellae

failed to be isolated from both plants. These results within the aeeeptable limit of Egyptian standard for frozen raw meat.

The data present in table (2) indicated that APC in final product samples in plant (A) ranged from 2.4×10^2 to 2.6×10^2 with mean value $8.71 \times 10^2 \pm 1.44 \times 10^2$.

On the other hand, in plant (B) ranged between 2.4×10^4 and 3.5×10^5 with a higher mean value $10.82 \times 10^4 \pm 1.73 \times 10^4$. Most samples reached the top of acceptable limit. There are significant differences in APC of examined samples between plant (A) and plant (B) at $P<0.05$. Staphylocoecus aureus could not be detected in plant (A) while in plant (B) it was detected in high incidence, constituting 70% of eollected samples.

Salmonellae failed to be detected from both plants. Results were compared with Egyptian standard for requirement of burger.

The results obtained in table (3) showed that APC of swabs collected from food contact surroundings; hand of workers, walls, and contact surfaces machines were $1 \times 10^{-1} \times 10^2$ with mean value $4.4 \times 10 \pm 0.62 \times 10$, 0 - 10 with a mean value 5.2 ± 1.0^2 and 0 - 10 with mean value 6.4 ± 0.98 in plant (A), respectively; while in plant (B) were from 1×10^2 - 1×10^5 with mean value $3.68 \times 10^3 \pm 2.014 \times 10^3$, 0 - 10 with mean value 6.4 ± 0.98; $1 \times 10^{-1} \times 10^3$ with mean value $2.58 \times 10^2 \pm 7.6 \times 10$; respectively.

The data present in table (4) revealed that the range and mean values of APC of samples after grill in plant (A) were 0-8, 2.28 ± 0.47, while in plant (B) ranged from $1 \times 10^{-8} \times 10$ with mean value $3.88 \times 10 \pm 0.44 \times 10$.

DISCUSSION

For a long time baeteriological techniques have been successfully employed to evaluate the microbial quality of beef burger and to determine the effect of microbial load on shelf life of these products. The bacterial population in ground meat reflects the bacteriological quality of meat used for grinding, cleanliness of equipment, the time and temperature of storage samples of ground beef are clearly indicative of the history of the product.

The obtained results, revealed that frozen raw meat in plant (A) and plant (B) showed nearly similar APC the applied statistical t-test confirmed that there was no significant differences, and both within the acceptable limit of APC stipulated by the Egyptian Standard for frozen raw meat.

The total colony count gives an idea about the hygienic measures applied during processing and also help in the determination of the keeping quality of the meat. So, the total colony count was the most reliable method for detection of sanitary processing of proper storage of food production.

Results showed that frozen raw meat in plant (A) was free from Staphylococcus aureus, while in plant (B), it was detected in 20% of examined samples. These results nearly similar to **Tolba (1994) and Badawy (2004)** which isolated this microorganism in food poisoning outbreaks, equipment, environmental surfaces can also be sources of contamination and may be due to fat the

point of delivery). The meat is hoisted onto the shoulders of a porter wearing a dirty blood stained coat.

Our results confirmed that Salmonellae failed to be detected in all steps of processing of burger samples of both plants .

This spoilage can be occurred from certain miero-organisms which rapidly multiply and caused discase. This can be dangerous as under unsanitary conditions and improper temperature control doubles in number every 20 minutes. This agrees with that reported by **(Marriot, 1994)**.

Results revealed that the mean value of APC of examined final burger product samples of plant (A) within the acceptable limit of ES requirements, nearly similar results obtained by **Mohammed (1997)** but lower than **Amal El- Sherif (1983), Yassien (1988)** Staphylococeus aureus failed to be detected in plant (A), this may be due to application of total commitment of management and employees to hygiene and even beyond (food handlers usually with good hygiene seores); design, environment, equipment, waste disposal system and operations under control; toilet and hand-washing facilities in working condition and well - equipped; refrigeration systems present but some improvements required by applying haccp principles and also duc to good hygienie praetices and high standard personal hygiene of applied quality assurance program. Nowadays, consumer attitudes towards food safety have started to evolve and both the local and export market are becoming increasingly stringent about food quality and safety.

Vice versa, in plant (B) most samples recorded higher number than plant (A) although results within (ES) but these results were recently obtained after processing microorganisms can multiply because animal products should be stored at low temperatures to prevent microbial proliferation this held the view reported by **(Springer, 1993)**. Out observation, plant (B) store raw materials and end- products at freezing tempcratures except for processed and sold at ambient temperatures.

Guidelines for fresh meat products consider a total aerobic in excess of $5x10^6$ organisms/g as a bad indication **(Janewalt and Guy, 1980)**.

Nearly similar results recorded by **Ouf (2001) and El- Mossalami (2003)**.

This also may be attributed to the commitment of management and employees: environment, waste disposal, design of storage and preparation rooms not taken care of control of operations good; food handlers given little facilities and have poor hygienelevel, require many improvements. This is in-accordance with that reported by **(Vytelingum et al 2000)**.

In pant B staphylococcus aureus was present in high incidence (70%) of final burger product samples. **Bang et al. (2008)** reported that Staphylococcus aureus contamination and enterotoxin production is a potential food safety hazard, nearly similar results obtained by **Ouf (2001) and Elelwa (2003)**. In practice what can be seen in plant (B) an employee happily picking his nose while waiting

for production line. Rules are being ignored whilst management complain about the cost of providing clean protective clothing daily. The whole system is conducive to microbiological growth. This habits in plant (B) illustrate why the results of Staphylococcus aureus is highly positive. Staphylococci are present in the nasal passages and throats and on the hair and skin of 50 percent or more of healthy individuals **FDA (2005)**.

Our results revealed that (plant A) was lower than plant (B) in APC of workers, walls and machines respectively that is due to the microbial quality of processing factories from slaughtering to retail display. This supported by findings reported by **(Greer and Jeremain, 1980)**.

Food-handling personnel play an important role in ensuring food safety throughout the chain of production, processing, storage and preparation. Mishandling and disregard of hygienic measures on their part may enable pathogens to come into contact with food and, in some cases to survive and multiply in sufficient numbers to cause illness in the consumer **(WHO, 1980)**.

Mishandling of food as well as uncleaned equipment surfaces were the most sources of contamination **(Bryan and Lyon, 1984)**.

Rules about washing hands before contacting foods, use of utensils to handle products, disposable gloves, clean clothes, and protected hair need to be applied regardless of the size of the operation.

The compliance of employees with good manufacture practice (GMP), cleaning and sanitation program were the main control points at this step. So, the hygienic measure of utensils and employees were examined. Recently food borne illness was increased from the consumption of meat and meat products which were contaminated with human bacterial pathogens.

There-fore, they constitute public health hazard as well as economic losses throughout their deterioration.

Heat treatment had a significant effect on bacteriological quality of the beef burger. It is generally accepted in meat hygiene that meat used for human consumption should be free from pathogenic microorganisms and may contain the least number of non pathogenic microorganisms.

Meat products may be contaminated with microorganisms from meat handlers who are carrying of these pathogenic microorganisms during manufacturing packaging and marketing of these products. Improper cooking, refrigeration or storage may lead to meat borne illness.

Inadequate cooking cause several outbreaks of foodborne diseases in England and Wales, United State and New South Wales and Australia **(Bryan 1978; Roberts, 1982 and Davey, 1985)**.

The present data that (plant A) indicated that cooking minimize APC. Therefore the results were lower than those obtained by (De **Curtis et al. (2000)** and **Pruett et al. (2002)**. Also plant (B) revealed that APC higher than

plant (A) but it is also decreased due to cooking.

Grilling the meat patties in clamshell grill at constant temperature (Higer plate Temperature 218°C and lower surface temperature 177°C and constant time 43 ± 2 seconds to the destruction at pathogen is achieved by cooking the meat to at least 66°C inadequate cooking cause several out breaks of food born diseases.

It is recommended that the advice to cook burgers until the juices run clear and there are no pink bits inside.

A high APC values does not constitute a risk to health but in a cooked product it may indicate an overall lack of hygiene.

Hygiene could be assessed through (GMP) which include temperature control, cleaning and disinfection, and food handlers for plant (B).

Some recommendations are formulated at various levels to improve hygiene in both plants. At the level of the food industry, internal hygiene control in the food industry can be implemented, specially through voluntary control programmes at the institutional level.

In conclusion we should apply system from stable to table based on HACCP and good manufacturing practice for all stages of production and handling of burger.

Table (1): Results of bacteriological examination of frozen raw meat samples in two meat processing plants compared with Egyptian standard (ES-2005):

Criteria	Plant (A)	Plant (B)	ES limit
Aerobic plate count:			
- Range	$1.1 \times 10 - 2.4 \times 10^2$	$1.3 \times 10 - 3.1 \times 10^2$	10^3
- Mean ± SE	$5.5 \times 10 \pm 1.1 \times 10$	$6.28 \times 10 \pm 1.32 \times 10$	
Incidence % of pathogens:			
- *Staphylococcus aureus.*	0	20%	
- *Salmonellae.*	0	0	
t(p)	0.449 (0.656)	0.337 (0.738)	

Table (2): Results of bacteriological examination of final product samples in two meat processing plants compared with Egyptian standard (ES):

Criteria	Plant (A)	Plant (B)	ES limit
Aerobic plate count:			
- Range	$2.4 \times 10^2 - 2.6 \times 10^3$	$2.4 \times 10^4 - 3.5 \times 10^5$	10^5
- Mean ± SE	$8.71 \times 10^2 \pm 1.44 \times 10^2$	$10.82 \times 10^4 \pm 1.73 \times 10^4$	
Incidence % of pathogens:			
- *Staphylococcus aureus.*	0	70%	
- *Salmonella.*	0	0	
t(p)	6.190* (<0.001)	8.277* (<0.001)	

t: Student t-test

* : Statistically significant at $p \leq 0.05$

Table (3): Results of total colony count of workers , walls and machines, in two processing plants

	Workers (n= 25)	Walls (n= 25)	Machines (n= 25)
A			
Range	$1 \times 10 - 1 \times 10^2$	0.00 – 10.00	0.00 – 10.00
Mean ± SE	$4.4 \times 10 \pm 0.62 \times 10$	5.2 ± 1.02	6.4 ± 0.98
B			
Range	$1 \times 10^2 - 1 \times 10^5$	0.00 – 10.00	$1 \times 10 - 1 \times 10^3$
Mean ± SE	$3.68 \times 10^3 \pm 2.014 \times 10^3$	6.4 ± 0.98	$2.58 \times 10^2 \pm 7.6 \times 10$
t (p)	1.806 (0.077)	0.849 (0.400)	3.313* (0.003)

t: Student t-test

* : Statistically significant at p ≤0.05

Table (4): Total colony count of final product of burger (after grill) in two processing plant.

Criteria	Plant (A)	Plant (B)
- Range	0 – 8	$1 \times 10 - 8 \times 10$
- Mean ± SE	2.28 ± 0.47	$3.88 \times 10 \pm 0.44 \times 10$

REFERENCES

APHA (1992) : American Public Health Association Compendium of Methods for the Microbiological Examination of Foods, 3rd Ed. Washing, D.C., USA.

Badawy, A. B. A. (2004) : Quality assuranee of imported frozen meat. M. V. Sci., Fac. Vet. Med., Alexandria Univ., Egypt.

Bang, W. I., Hanson, D. J. I. and Drake, M. A. I. (2008) : Effect of salt and sodium nitrite on growth and enterotoxin production of Staphylococcus aureus during the production of Air-Dried Fresh Pork Sausage, J. Food Prot. 71, 191-195.

Bryan, F. L. (1978) : Factors that contribute to outbreaks of foodborn diseases, J. Food Prot. 41: 816-827.

Bryan, F. L. and Lyon, J. B. (1984) : Critieal control points of hospital food service operations. J. Food Prot. 47:950.

Davey, G. R. (1985) : Food poisoning in New South Wales: 1977-84 Food Technology in Australia, 37, 453-456.

De Curtis, M. L.; Franceschi, O. and De Castro, N. (2000) : Assessment of microbiological quality of food served in dining rooms of private enterprises, Arch Latinoam Nutr. 50: 177-82.

Egyptian Standard Legislation (2005) : Egyptian Organization for Standardization and Quality Control. Egyptian Standard Specification for Burger: 1688-2005.

El-Mossalami, E. I. K. (2003) : Risk assessment of ready-prepared meat products. Ph. D. Thesis, Fae. Vet. Med., Cairo Univ.

FDA (2005) : Staphylococcus aureus. Bad Bug Book. Foodborne Pathogenic Microorganisms and Natural Toxins Handbook (1992/ updated 2005). USFDA/FDA, Center for Food Safety & Applied Nutrition.

Greer, G. G. and Jeremain, L. E. (1980): Effect of retail sanitation on the bacterial load and shelf life of beef. J. food proteet., 43:277.

ICMSF (1996) : Microorganisms in Food, Vol. 1, their signifieance and methods of enumeration. 2nd Ed. Univ. Toronto press, Toronto Canada.

Janewalt, C. and Guy, (1980) : Relation of microbial quality of retail meat samples and sanitary condition. J. Food protect 43:385.

Ouf, J. M. M. (2001) : Microorganisms of sanitary importance in some meat products and their additives. Ph. D.Thesis Fac. Vet. Med. Cairo, University.

Marriot, G. N. (1994) : Prineiples of Food Sanitation. Chapman and Hall, New York.

Mohammed, M. M. S. (1997) : Quality studies on the market frozen meat product M.V.Sc. Thesis (Meat Hygiene), Fac. Vet. Med., Cairo University.

Elelwa, E. H. E. (2003) : Effect of chemical preservatives on food poisoning bacteria in

some locally-manufactured meat products. Ph. D., Fac. Vet. Med., Moshtohr, Zagazig University.

Pruett, W. P. Jr.; Biela, T.; Lattuada, C. P.; Mrozinski, P. M.; Barbour, W. M.; Flowers, R. S.; Osborne, W.; Reagan, J. O.; Theno, D.; Cook, V.; McNamara, A. M. and Rose, B. (2002) : Incidence of Escherichia coli O157:H7 in frozen beef patties produced over an 8-hour shift. J Food Prot. 65: 1363-70.

Roberts, D. (1982) : Factors contributing to outbreaks of food poisoning in England and Wales 1970-1979. Journal of Hygiene, 49-198.

Springer, R. A. (1993) : Hygiene for Management: a text for Food Hygiene Courses. Highfield Publications. U.K.

Tolba, K. S. (1994) : Microflora in locally-processed frozen meat. Vet. Med. J. Giza. 42 99.

Vassilliadis, P.; Tripchopoulos, D., Pateraki E. and Papaioano-Mou, N. (1983) : Isolation of Salmonella from minced meat by the used of a new procedure of enrichement. Zentrablatt Eür Bacteriologie, Parasitea Und Infections Krankheiten Und. Hygiene,B 166: 81.

WHO (1980) : "Health examination of food-healing personnel" Report of working group Copenhagen. WHO Regional Office for Europe.

WHO (2000) : "Foodborne disease: A focus for health education", Geneva.

Yassien, N. A. (1988) : Sanitary improvements of locally-manufactured meat products. Ph. D., thesis, (Meat Hygiene), Fac. Vet. Med., Cairo University.

Vytelingum, S. A.; Goburdhun, D. and Rugg, A. O. O. (2000) : An Assessment of the hygiene level in animal product processing plants in Maurtitius. Scienee and Technology Research Journal 83-104.

الملخص العربى

تقييم الجـودة الصحيحة للبرجـر فى مصنعين بمحافظـة الإسكندريـة

وفـاء عيسـى نبيلـه سـليمـان

معمل بحوث صحة الأغذية بجمرك الإسكندرية - معهد بحوث صحة الحيوان*

تم هذا التقييم داخل مصنعين لإنتاج البرجر فى محافظة الإسكندرية حيث أن المصنع الأول يطبق برنامج توكيد جودة وأمان المنتج والثانى ينتج ويراقب بالطريقة التقليدية من خلال الفحص البكتريولوجى (العد الكلى للبكتريا الهوائية، عزل الميكروب العنقودى الذهبى وأيضاً عزل ميكروب السالمونيلا) لعينات اللحم الخام المجمد والمنتج النهائى للبرجر بالإضافة إلى مراقبتنا لبيئة التصنيع داخل المصنعين بدءاً من اللحم الخام وحتى تصل إلى المستهلك وقد تم سحب مسحات من البيئة المحيطة بالمنتج أيضاً (الأسطح الملامسة) من العمال والحوائط وكذلك الماكينات. وتبين لنا أن الجودة البكتيرية للحم الخام المجمد متماثلة تقريباً فى المصنعين وهى فى الحدود المسموح بها عدا أنها موجود بها الميكروب العنقودى بنسبة ٢٠٪ ، نتائج الفحص البكتريولوجى للمنتج النهائى لعينات البرجر فى المصنع الأول كانت جيدة ولكن فى المصنع الثانى معظم العينات كان العد الكلى للبكتريا الهوائية عالى و ٧٠٪ منها ملوث بالميكروب العنقودى الذهبى وكانت جميع العينات خالية من ميكروب السالمونيلا.

كما تبين لنا من نتائج الفحص البكتريولوجى للمسحات التى تم جمعها من العمال والحوائط والماكينات (الأسطح الملامة للمنتج) أن المصنع الأول أعطى نتائج جيدة فى حين أظهر المصنع الثانى نتائج عالية والنظام المطبق فى المصنع الثانى على وجه العموم يشجع على النمو البكتيرى، أما النتائج الخاصة بالمنتج النهائى فى العد البكتيرى الكلى بعد الطهى أوضحت أنها فى المصنع الأول والمصنع الثانى جيدة وهى تعتمد على وقت طريقة الطهى، وقد تم مناقشة وصياغة مستويات التصنيع وتقييم كل مستوى والاشتراطات الصحية المطلوبة لتحسين الجودة الصحية فى كلا المصنعين لإنتاج منتج آمن وعالى الجودة.