



## Base Line Survey on Implementation of Good Manufacturing Practices (GMP) in Meat Processing Factories in Khartoum State, Sudan

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### ABSTRACT

The present study was conducted in meat processing factories in Khartoum state to evaluate the implementation of good manufacturing practices (GMP), and its related risk factors. GMP is considered an important system used in food safety, and associated with minimum sanitary and processing requirements for food industry. The data were collected by means of a questionnaire survey administered to 40 respondents from eight factories in Khartoum state which were selected using a multi stage – cluster sampling method. A description of the respondents with regard to the implementation of GMP revealed that most of them were female 62.5% (n = 25) and the age group of 25-35 years was most frequent 75% (n = 30). 82.5% (n=33) of the respondents graduated from secondary schools and 90% (n=36) working in production lines, respectively. Moreover, a low percentage of 20% (n=8), obtained for training on Hazard Analysis Critical Control Point (HACCP) and GMP as well as most of them with working experience of 1-2 years given a percentage of 42% (n=17). On the other hand, results of the GMP survey in plants and facilities revealed that; sanitation and hygiene practice was limited to 45% (n=18). For instance a percentage of 27.5% (n=11) was recorded for waste and offal treatment but 55% (n=22) use ventilation and lighting, respectively. The similar observation was obtained for water and electric supply in 37.5% (n=15) plants and facilities and 42.5% (n=17) apply pest control and pesticides. Regarding personal hygiene practices, such as hands washing, clothing's and personal belonging the number of plants were also very limited 27.5% (n=11), 25% (n=10), respectively. Furthermore, observation on sanitation procedures was also not good, and found in 45.5% (n=17); 35.5% (n=14) were recorded for sanitation of food contact surfaces and training on sanitation. Furthermore, a low percentage was also recorded in the GMP survey for equipment and utensils; 32.5% (n=13) have equipment wash area and 40% (n=16) equipment sanitation. In conclusion, the present study revealed that the good manufacturing practices (GMP) system in meat processing factories in Khartoum state presents still a great challenge. Hence, good hygiene practices should be applied throughout the preparation chain, so that the meat and products can be safe for human consumption.

**Keywords:** Good Manufacturing Practices (GMP), Meat Processing Factories, Sudan

## INTRODUCTION

In developing countries, consumption of meat will move towards that of developed countries where the meat consumption remains stagnant at a high level Kostadinova, (2007) & FAO, (2014). Boye, (2012) stated that in meat –product manufacturing, the basic processing technologies, such as cutting and mixing, are accompanied by various additional treatments and procedures, depending on the type and quality of the final product. Such treatments involve curing, seasoning, smoking, filling into casings or rigid containers, vacuum packaging, cooking or canning/sterilization Alonge, (1991).

Due to the importance of these procedures, suitable and the equipment needed. Processing technologies for meat products will not deliver satisfactory results if there is no adequate meat hygiene in place. In the interest of food safety and consumer protection, increasingly stringent hygiene measures are required at national and international trade levels .key issues in this respect are Good Hygienic Practices (GHP) and Hazard Analysis and Critical Control Point Schemes, (HACCP). FAO, (2003).

Moreover, Fidel (2010) reported that microorganisms cause indispensable in modern meat processing. Thus, along with technological aspects of meat processing, the manual includes reference to related aspects of meat processing hygiene including cause of meat product spoilage and food borne illnesses as well as cleaning and sanitation in meat processing for the purpose of consumer protection and the quality control of meat products Batter (2013). Annali (2011) state that Meat processing involves a wide range of physical and chemical treatment methods, normally combining a variety of methods.

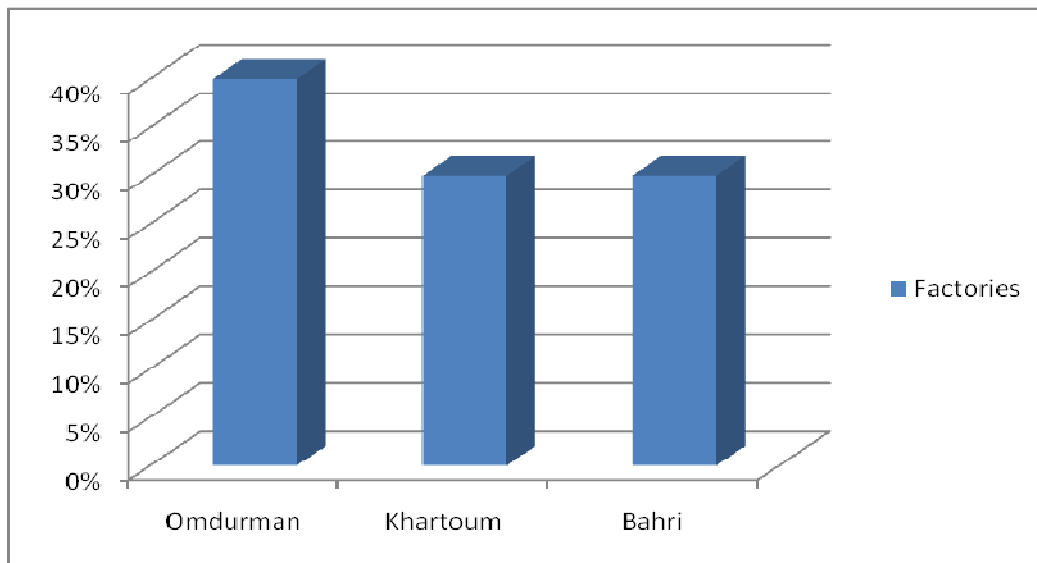
On the other hand, meat and slaughter industry in Sudan needs to receive on-going support in order to satisfy highly demanding international standards as well as the production premises have to be in harmony with Sudanese standards for good manufacturing practice (GMP), Hence, the objectives of the present study are:

1. To evaluate the implementation of the Good Manufacturing Practices (GMP) in the meat processing factories in Khartoum state, Sudan.
2. To examine employees' attitudes on the implementation of Good Manufacturing Practices (GMP) System in the meat processing factories in Khartoum state, Sudan.
3. To determine some of the risk factors that associated with Good Manufacturing Practices (GMP) in the meat processing factories in Khartoum state, Sudan.

## MATERIALS AND METHODS

### Study site

Khartoum, the national capital of Sudan located in central Sudan at the confluence of the Blue Nile and the White Nile rivers. The Sudanese metropolis consists in fact of three cities: Khartoum, Khartoum North (Bahri), and Omdurman and located between the latitude 15.08–16.39° N and longitude 31.36–34.25°E. The population of Khartoum in 2004 Census was estimated as more than 8 million inhabitants. Michael *et. al.* (1976), stated that Geographically Sudan climate is semi-desert, dry and hot in summer (maximum temperature 37.1C and minimum temperature 22.7C with the range of rain of 150mm. On the other hand, meat processing factories in Khartoum State were 10 plants according to the Sudanese Ministry of Industry and Ministry of Animal Resources reports. Two plants out of work and the rest are still working properly as shown in (Figure 1)



**Figure (1):** Meat Processing Factories in Khartoum State

### Questionnaire Survey

The questionnaire survey was done in eight meat and poultry processing factories in Khartoum state. A total of 40 questionnaires were distributed, five questionnaires for each factory. Three of these factories were located in southern borders of Khartoum city in Albagair industrial area, and Tayba-Alhassanab south -west of the city. While, other three factories located in Omdurman industrial area, as well as one of them located in Bahri. The questionnaire was divided into two sections the first one associated with general information, and the second one included all the Good Manufacturing Practices (GMP) check list related to the Sudanese standard

### Selection of the Respondents

Method of the selection was done at different level (site, factories and respondent) and this method called Multi-Stage Cluster Sampling as described by Thrusfield (2007).

### Research hypothesis

There was a significant difference in employees' attitudes on the implementation of Good Manufacturing Practices (GMP) System when classified by the independent factors such as gender, age, education level, working experience, working position, and GMP training experience. The dependent variables were GMP principles which included buildings and facilities, equipment and utensils, production and process controls, sanitation, maintenance, and personnel hygiene practices.

### The Sudanese Standard for Good Manufacturing Practices (GMP)

It was set by Sudanese Technical Committee (STC) of meat in the year 2013, with the standard number SDS 4945:2013, and it concerns about requirements of good manufacturing practices (GMP) for meat and meat- products, including group of recognized scientific methods and applied practices which agree with safety and quality assurance standards in producing meat- products in accordance with metrological standards and issued regulations to insure quality and safety of meat-products. The committee composed of members from different institutes and universities that participate in setting and updating the standard, SSMO (2013).

## The Standard Requirements

1. Technical requirement
2. The processing plant where the product is prepared should comply with regulations of Sudanese standards no 2573/2010 (meat and meat products).
3. The source of meat should be an animal whose meat is allowed for human consumption and slaughtered according to the Islamic sharia rules according to the requirements in the Sudanese standard no SDS 039/2010.
4. Preparation, processing and handling operations should be done according to the Sudanese standards no SDS 4051/2008 (requirements of Halal Food).
5. Requirements of food safety managements should comply with requirements stated in International Standardization Organization (ISO), and food safety management systems. SDS 4045/2008 ISO, (22000). Etc.

## Statistical analysis

Data analysis was conducted using SPSS for (Windows XP, 2010). Descriptive statistics were used for all variables. While, chi square was used to assess the statistical association between factors and implementation of Good Manufacturing Practices (GMP). The logistic regression model was employed to obtain the Odds Ratio (OR) only for the independent factors which gave statistical significant. Odds Ratio (OR) could be a risk factors when the  $OR > 1$ .

## RESULT AND DISCUSSION

Questionnaire survey on implementation of good manufacturing practices (GMP) revealed that: most of them were female 62.5% (n = 25) and the age group of 25-35 years was most frequent 75% (n = 30). Most of the respondents graduated from secondary schools 82.5% (n=33) and working in production lines 90% (n=36). Moreover, low percentage of 20% (n=8), was obtained by training on Hazard Analysis Critical Control Point (HACCP) and GMP as well as most of them with working experience of 1-2 years given a percentage of 42% (n=17), the results are presented in Table 1.

On the other hand, the results of GMP survey on plants and facilities revealed that; sanitation and hygiene practice was limited 45% (n=18). Fore instance low percentage 27.5% (n=11) and 55% (n=22) were recorded for waste and offal treatment & ventilation and lighting, respectively. The same observation was obtained for water and electric supply 37.5% (n=15) and pest control and pesticides 42.5% (n=17) (Table 2). Regarding GMP survey on personal hygiene practices, such as hands washing, clothing's and personal belonging, gloves, head and foot wearing as well as diseases control, were also very limited 27.5% (n=11), 25% (n=10), 42.5% (n=17) and 37.5% (n=15) respectively (Table 3).

Furthermore, observation with regard to GMP survey on sanitation procedures was also not good, percentage of 45.5% (n=17), 35.5% (n=14), 25% (n=10), 30% (n=12), and 42.5% (n=17), were recorded for sanitation of food contact surfaces, training on sanitation, truck cleanliness, sanitation of hooks, walls, equipment and utensils (Table 4). Furthermore, low percentage was also recorded for GMP survey on equipment and utensils. Fore instance equipment wash area 32.5% (n=13), and equipment sanitation 40% (n=16) (Table 5).

**Table 1:** Association between the (GMP) implementation and some factors

<b>unit</b>	<b>Count</b>	<b>Percentages%</b>
<b><u>Gender</u></b>		
<b>Male</b>	<b>15</b>	<b>37.5%</b>
<b>Female</b>	<b>25</b>	<b>62.5%</b>
<b><u>Age</u></b>		
<b>20-25</b>	<b>01</b>	<b>2.5%</b>
<b>25-35</b>	<b>30</b>	<b>75%</b>
<b>&gt;35</b>	<b>09</b>	<b>22.5%</b>
<b><u>Education level</u></b>		
<b>Primary</b>	<b>04</b>	<b>10%</b>
<b>Secondary</b>	<b>28</b>	<b>70%</b>
<b>Graduate</b>	<b>08</b>	<b>20%</b>
<b><u>Working position</u></b>		
<b>Production line</b>	<b>30</b>	<b>75%</b>
<b>Administration</b>	<b>05</b>	<b>12.5%</b>
<b>Quality control</b>	<b>04</b>	<b>10%</b>
<b>Labour</b>	<b>01</b>	<b>2.5%</b>

<b><u>Working experience</u></b>		
1- 2 years	30	75%
3- 4 years	10	25%
> 4 years	00	0.0%
<b><u>Training on HACCP &amp; GMP</u></b>		
Yes	8	20%
No	32	80%

Total No. of respondents= 40

**Table 2:** The results of Good Manufacturing Practices (GMP) Survey On plant and facilities

Unit	Frequency	Percentage%
<b><u>Plant and Ground around</u></b>		
Yes	13	32.5%
No	27	67.5%
<b><u>Design and construction</u></b>		
Yes	20	50%
No	20	50%
<b><u>Sanitation and hygiene practice</u></b>		
Yes	18	45%
No	22	55%
<b><u>Waste and offal treatment</u></b>		
Yes	11	27.5%
No	19	72.5%
<b><u>Ventilation and lighting</u></b>		
Yes	22	55%

No	18	45%
<b><u>Floors, walls and ceiling</u></b>		
Yes	14	35%
No	26	65%
<b><u>Water and electric supply</u></b>		
Yes	15	37.5%
No	25	62.5%
<b><u>Toilet facilities and sewage</u></b>		
Yes	17	42.5%
No	23	57.5%
<b><u>Equipment installation</u></b>		
Yes	25	62.5%
No	15	47.5%
<b><u>Maintenance</u></b>		
Yes	09	22.5%
No	31	77.5%
<b><u>Sanitation procedures</u></b>		
Yes	17	42.5%
No	23	57.5%
<b><u>Prevention contamination</u></b>		
Yes	20	50%
No	20	50%
<b><u>Freezer and cold storage compartments</u></b>		
Yes	24	60%
No	16	40%
<b><u>Pest control &amp;pesticides</u></b>		
Yes	18	45%
No	12	55%

**Table 3:** The results of Good Manufacturing Practices (GMP) survey on Personal Hygiene Practices

Unit	Frequency	Percentage %
<b><u>Personal cleanliness</u></b>		
	32	80%
Yes	08	20%
No		
<b><u>Hands washing facilities</u></b>	11	27.5%
	29	72.5%
Yes		
No		
<b><u>Distribution hand washing stations</u></b>	12	30%
	28	70%
Yes		
No	10	25%
<b><u>Clothing and personal belongings</u></b>	30	75%
Yes	17	42.5%
No	23	57.5%
<b><u>Gloves, head ,and food wearing</u></b>	16	40%
Yes	24	60%
No		
<b><u>Eating , drinking ,gum chewing</u></b>	13	32.5%
Yes	27	67.5%
No		
<b><u>Implementation of hygiene practices</u></b>	15	37.5%
	25	62.5%
Yes		



No	20	50%
<u>Disease control</u>	20	50%
Yes		
No	21	52.5%
<u>Injuries and wounds control</u>	19	47.5%
Yes		
No		
<u>Victors and contractors timetable</u>		
Yes		
No		

**Table 4:** The results of Good Manufacturing Practices (GMP) survey on Sanitation Procedures

Unit	Frequency	Percentage
<u>Sanitation of physical substances and other material</u>		
Yes	18	55%
No		
<u>Sanitation of food contact surfaces</u>	22	45%
Yes		
No		
<u>Cleaning compounds and sanitizing agents</u>	14	35%
Yes		
No	26	65%
<u>Training on sanitation</u>		
Yes		
No	21	52.5%
<u>Trucks cleanliness</u>		
Yes		

No	19	47.5%
<b><u>Prevention of contamination</u></b>		
Yes		
	10	25%
No		
<b><u>Sanitation and hygienic practices</u></b>		
Yes		
	30	75%
No		
<b><u>Sanitation of floors, walls, and Equipment</u></b>		
Yes		
	12	30%
No		
	28	70%
	20	50%
	20	50%
	18	45%
	22	55%
	17	42.5%
	23	57.5%

**Table 5:** The results of Good Manufacturing Practices (GMP) survey on Equipment and Utensils

Unit	Frequency	Percentage %
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<b><u>Equipment's wash area</u></b>		
Yes	13	32.5%
No	27	67.5%
<b><u>Equipment sanitation</u></b>		
Yes	16	40%
No	24	60%
<b><u>The stainless steel materials</u></b>		
Yes	23	57.5%
No	17	32.5%
<b><u>Equipment's installation</u></b>		
yes	20	50%
No	20	50%
<b><u>Calibration</u></b>		
Yes	19	47.5%
No	21	52.5%

## Discussion

According to employees' attitudes on the implementation of Good Manufacturing Practices (GMP) System in meat processing factories in Sudan. The arithmetic mean was at low level, because all products were not strictly examined to ensure world-class quality such as Food Safety, Quality Marks, GMP, HACCP, ISO 9001:2000, and Halal (nationally and internationally).

Six factories out of ten they don't have laboratory techniques of their own, which help on early detection of hazards. Factories situation were very poor from the view of location, building, and facilities. The building were made from materials that are not safe for meat production the walls were cracked and the floors were not straight, also there was some holes which can be source of bacterial growth and contamination. Moreover, the design of the buildings leaves no enough space for machines to facilitate cleaning and sanitation. Also the water used in processing was not laboratory checked.

The lowest mean of employees' attitudes on the implementation of Good Manufacturing Practices (GMP) System was the sanitation. The majority of staff had no training in sanitation procedures of

the plant or premises. Therefore, the top management should provide the training course in the topic of sanitation operations to employees (such as the plant's sanitation program). In addition, it is very important for all employees in different age, working experience, working position, and GMP training experience to learn and practices on Good Manufacturing Practices (GMP) System. To reduce the public health risks increasing from food contamination, (Anderson 2013).

Adopting Good Manufacturing Practices (GMP) are important principles of management which guarantee the food safety production and performance with legal requirement. Strict commitment of management practices with high quality standards of food safety is essential. Furthermore, the study reflects a lack of general hygiene at the environment around the buildings. (Anderson 2012) reported that: meat processing should be done in a clean environment. Moreover, no processing preparation such as washing handlers hands, the same finding were notice by (Patricia, 2011). Who reported that in addition to contamination of meat with hands, high risk might occur from worker suffering from certain disease. Moreover, the study revealed that there was several problems such as sanitation, bad handling of raw meat from abattoirs, during transportation, and storage, to final processing plant, bad infrastructure, poor shilling, high ambient temperature.

The factories did not have regular programme for cleaning, and sanitation, collection of waste and offal's and insect control and the routine work of cleaning, sanitation of equipment, utensils, and food contact surfaces that used for processing. Utensils used for meat processing should be sterilized, and sanitized before used and kept clean after finishing from work. The habits and personal hygiene of meat handlers are too poor, they don't clean their hands, and beside the law level of education, they have not been involved in any training courses about hygiene and general health. This also was in agreement with the report of (Alonge, 1991) who reported that training is an important and useful. It's well known that poor meat hygiene reflects bad effects on public health since many food – borne diseases and conditions may be originated from meat sources, so distribution of contaminated meat is risky for human health, and effect meat shelf life.

Good manufacturing practices system is very important in preventing meat contamination and food borne diseases control, but GMP has prerequisites need to be fulfilled before application to control hazards in meat sector especially in processing chain. It has been proved clearly from this study that wide gap exist between reality regarding meat hygiene situation and needed and absolutely essential meat hygiene requirements including (HACCP & GMP) systems which has been nowadays compulsory requirement in meat sector in an increasing number of population around the world.(Michael, 2013)

A few of the factories in this study had the opinion that the GMP standard is too heavy and though for a factory with a small production. Costly investments such as recruitments or reconstructions were often needed during the implementation process due to that the factories did not have the resources required to meet all the demands from the start. Companies that plan well and have enough time for implementing the certificate will get an advantage and be better prepared. It is important to be committed and to have a positive approach to the implementation as well as to set up target dates. Lack of time seems to be a common problem and this might have been handled well if the knowledge about the implementation process had been better. The management must be supporting and understanding to achieve a good result with the standard. In the factories included in this study the management seems to have been relatively engaged and even if some of them lacked previous experience of certificates they aimed for a good result for the whole company.

The factories consider they benefit from the standard in a way that their customer relations improve and their sales increase. One factory did not agree on that but this might be due to that the companies operate in quite different line of meat business with local market conditions. The

factories in this study produce very little kind of products; the size of the factories may also affect how well the implementation process works and how the adjustment to the standard is handled. In the study (Algoosi), is a factory with the highest turnover and highest number of employees; they also produce meat products that are very sensitive in the context of quality and food safety. Although, it was not satisfied with the GMP standard for a few reasons.

In conclusion, the status of Good Manufacturing Practices (GMP) system in meat factories was found not good, so corrective actions must be placed in order to minimize food contamination. Hence, Poor sanitation procedures lead to Good Manufacturing Practices ( GMP) system failure.

### RECOMMENDATIONS

1. Good hygiene practices should be applied throughout the preparation, processing, and distribution chain so the meat and meat- products can be safe for human consumption.
2. Good agricultural practices (GAP) should be implemented in tabular for each step, animal feeding, welfare and environments, water, and animal health, so GAP/GMP together would be effective.
3. Improvement of workers and their management awareness of meat and meat- products safety through training, and courses in GMP system.
4. Government has the responsibility to protect consumers from food-borne hazards, methods of food safety control, HACCP,GMP, GHP, GAP, and other international standards, which is accepted as the best way to assure consumer safety in the production foods , throw strict legislations and instructions, so more researches is needed to broaden this research first, as this research concentrated in meat processing , future research should study across different factories and companies, in different sectors might emphasized the rule of different antecedents .Second, further study is needed to investigate more independent, and dependent variables such as, ISO18000, ISO9001:2000, and SOPS. To add information for implantation of GMP system in meat sector in Sudan
5. Implantation of clear system for meat processing from slaughtering, dressing, cutting, chilling, until delivered to the processors. Also rebuilding of plants according to the international standards of meat plants.
6. Development and application of GMP, HACCP, and use of sanitation standard operating procedures, (SSOP) and personal hygiene program in meat processing factories, and distribution chains in Sudan can accelerate the way for application of complete and effective GMP systems by producers and distributors and help accelerating efforts and effectiveness of meat contamination control by veterinary and public health authorities.

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