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The Effect of Socioeconomic Status of the Butcher Shops and Supermarkets on Microbiological Quality of Minced Meat in Alexandria City, Egypt

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Abstract
The microbiological quality of meat is dependent on the slaughtering, grinding operations, sanitation during processing and packaging, inadequate refrigeration, sanitation during handling and sanitation of workers and shops in general. A total of 140 ground beef samples were purchased from local butchers and supermarkets in Alexandria. Each of the minced beef sample was analyzed for its microbiological quality (total plate count, total coliform count and *E. coli* count). Out of the 140 studied minced meat samples, 34(24.3%) were collected from high (SES) sites, 61(43.6%) samples collected from the medium SES sites and 45(32.1%) low SES sites. This study examined whether the microbial quality influenced with the level of socioeconomic status for populations. It was calculated that the SES sites did not affect statistically the microbiological quality of the examined minced meat samples according to their APC, TCC and *E.coli* count. (P ranged from 0. 072 to 0. 812)**.**

Keywords: SES, microbiological quality, minced meat, APC TCC and E.coli count

Introduction
Many factors can influence which microbes are present on certain meat. After slaughtering, meat can be contaminated with bacteria from the water, air, and soil [1, 2]. These factors include the quality of the raw materials, other materials used or added during processing operations to the products as extraneous contaminants, sanitation during processing and packaging, maintenance of adequate refrigeration from the processor to the retail level and to the consumer and finally, sanitation during handling at the retail stores and efficacy of cooking process [3].

Minced meat is inherently more likely to be contaminated with bacteria than cuts of meat because of the way it is processed. Bacteria is present everywhere, but especially on the surface of meats. When meat is ground, bacteria are mixed throughout the mass of meat. The meats used for Minced beef are the cheapest cuts, found near the tail, (which is more likely to come in contact with feces, one of the sources of *E. coli*), slaughterhouse trimmings, and ground-up scraps [4].

Minced meat is not only highly susceptible to spoilage, but also is frequently involved in the spread of pathogens [5], which are major causes of illness and death worldwide [6]. It is resulting from ingestion of bacteria, toxins and cells produced by microorganisms present in food [7]. Recognizing this, the World Health Organization (WHO) developed its Global Strategy for Food Safety [8].The microbiological safety of food is achieved by as far as possible ensuring the absence of pathogenic microorganisms and by all means preventing their multiplication[9].

The microbiological profile of meat products is one of the key criteria for determining quality and safety of fresh produce. So in order to assess the microbiological safety from foodborne pathogens, widespread use of groups or species which are easily enumerated and whose presence in foods indicates exposure to conditions that might introduce hazardous organisms and/or allow their growth are used [10-12]. These groups are referred to as indicator organisms.These microorganisms are very good indicators concerning whether the food has been processed in hygienic conditions. The number of aerobic /coliform bacteria is a good

criterion in determining the hygienic quality of meat [13].
Aerobic plate counts (APC) often are chosen as an indicator of the effectiveness of Hazard Analysis Critical Control Point (HACCP) plans, because data for all aerobic bacteria are more easily collected than data for pathogens of concern or other indicator organisms[14]. *Enterobacteriaceae* are very useful as indicators of bad hygiene or bad treatment of food products, and their presence in large number indicates a big possibility of their multiplication, implying multiplication of other pathogens[15].
A common practice is to use tests for total coliform count (TTC), including *Escherichia coli (E. coli)* for screening and if there is reason to determine the likelihood of fecal contamination, the coliform or other *Enterobacteriaceae* are subjected to further tests to establish whether any of them are *E. coli.* [13].

Material and methods

Sample collection

One hundred grams of minced meat were obtained from workers in collection different socioeconomic status (SES) sites and placed in the food collection bags. Sample source and sample number was identified on sample form. Refrigeration of sample was used during transport. Frozen samples were kept frozen. A submission form for each sample was filled out including: type of meat and its color; date and locality of the collection site; name of butcher and its personal hygiene and sanitary condition of the shop.

Sample preparation

Ten gram of each sample were weighted and transferred to a stomacher bag under aseptic conditions. The sample was then diluted to a 10^{-1} dilution with 90ml of peptone water and homogenized for two min by using a Stomacher. Following homogenization, ten-fold serial dilutions for each sample were made in sterile peptone water up to 10^{-4}, by transferring 1 ml of previous dilution to 9 ml of peptone water**.**

Microbiological analysis

Aerobic Plate Count

One ml of each dilution was pipette into separate, appropriately marked Petri dish and to each plate, 12-15 ml plate count agar (cooled to 45 ± 1°C) was added within 15 min of the original dilution. After Petri dishes solidified were incubated promptly for 48 ± 2 h at 35°C. Plates with colony number between 30-300 colony-forming units (CFU) were selected, counted and multiplied by the dilution factor to calculate CFU/gram of minced meat.

Determination of coliform and *E. coli* using the Most Probable Number (MPN) method

First determining the presence of coliform in the Lauryl Sulphate Tryptose broth (LST) tubes, the positive LST tubes showing gas were subcultured into Brilliant Green Bile (BGB) broth and EC broth. All positive BGB tubes recorded as confirmed MPN of coliform bacteria per gram of minced meat, however gas production in the EC tubes was considered a confirmed test for fecal coliform organisms and subcultured onto Eosin Methylene Blue (EMB) agar plates and incubated for 24h at 35°C and examined for green metallic sheen colonies which then transfered to IMViC (Indole,Methyl red,Vogues-Proskauer and Citrate) tubes. MPN of *E*. coli per gram were computed considering producing ++-- or-+-- IMViC patterns.

Results and Discussion

The results were recorded according to the *Commission of the European Communities* [16] and the Egyptian guidelines [17,18] as satisfactory, acceptable and unsatisfactory.

Tables 1, 2 and 3 show the socioeconomic status (SES) of the site of sampling in relation to microbiological quality of the examined minced meat samples according to their APC, TCC and *E. coli* count.
Regarding the microbiological quality of the 140 examined minced meat samples, 34(24.3%) were collected from high SES sites. Out of these 16(47.1%) were satisfactory according to their APC parameter, while 10(29.4%) were acceptable and 8(23.5%) were unsatisfactory. The corresponding figures for the 61(43.6%) samples collected from the medium SES sites were 18(29.5%), 23(37.7%) and 20(32.8%) respectively. Those of the 45(32.1%) low SES sites were 23(51.1%), 15(33.3%) and 7(15.6%) respectively.
The collective means of the APC of these samples in the high, medium and low SES sites were 3.6×10^6 cfu\g, 5.2×10^6 cfu\g and 3.1×10^6 cfu\g respectively. **(Table 1).**
Table 2 shows the results of the previous samples according to their TCC. The corresponding figures for these samples were 9(26.5%), 19(31.1%) and 14(41.2%) respectively in the high SES sites, 17(27.9%), 23(37.7%) and 25(41.0%) respectively in the medium SES sites, and those of the low SES sites were 11(24.4%), 19(42.2%) and 15(33.3%) respectively.
The collective means of the TCC of the previous samples in the high, medium and low SES sites were 8.7×10^3 cfu\g, 1.1×10^4 cfu\g and 1.0×10^4 cfu\g respectively.
Table 3 shows the results of the previous samples according to their *E. coli* count. The corresponding figures for these samples were 14(41.2%) 18(52.9%) and 2(5.9%) respectively in the high SES sites, 33(54.1%), 19(31.1%) and 9(14.8%) respectively in the medium SES sites, and those of the low SES sites were 20(44.4%), 14(31.1%) and 11(24.4%) respectively.
The collective means of the *E. coli* count of the previous samples in the high, medium and low SES sites were 1.9×10^2, 2.2×10^3 and 2.9×10^3 respectively.
It was calculated that the SES sites did not affect statistically the microbiological quality of the examined minced meat samples according to their APC, TCC and E. coli count. (**P** ranged from **0. 072** to **0. 812**).

Table 1: Socioeconomic status of sampling sites in relation to microbiological quality of the examined minced meat samples according to APC.

SES Sites	Microbiological quality of ground meat								
	Satisfactory (n=57)		Acceptable (n=48)		Unsatisfactory (n=35)		Total (n=140)		Mean CFU\g
	No.	%	No.	%	No.	%	No.	%	

High	16	47.1	10	29.4	8	23.5	34	24.3	3.6×10^6
Medium	18	29.5	23	37.7	20	32.8	61	43.6	5.2×10^6
Low	23	51.1	15	33.3	7	15.6	45	32.1	3.1×10^6

Table 2: Socioeconomic status of sampling sites in relation to microbiological quality of the examined minced samples according to TCC.

SES Sites	Microbiological quality of ground meat								
	Satisfactory (n=37)		Acceptable (n=49)		Unsatisfactory (n=54)		Total (n=140)		Mean CFU\g
	No.	%	No.	%	No.	%	No.	%	
High	9	26.5	11	32.4	14	41.2	34	24.3	8.7×10^3
Medium	17	27.9	19	31.1	25	41.0	61	43.6	1.1×10^4
Low	11	24.4	19	42.2	15	33.3	45	32.1	1.0×10^4

Table 3: Socioeconomic status of sampling sites in relation to microbiological quality of the examined minced meat samples according to *E. coli* count.

SES Sites	Microbiological quality of ground meat								
	Satisfactory (n=67)		Acceptable (n=51)		Unsatisfactory (n=22)		Total (n=140)		Mean CFU\g
	No.	%	No.	%	No.	%	No.	%	
High	14	41.2	18	52.9	2	5.9	34	24.3	1.9×10^2
Medium	33	54.1	19	31.1	9	14.8	61	43.6	2.2×10^3
Low	20	44.4	14	31.1	11	24.4	45	32.1	2.9×10^3

Fig. 1, 2 and 3 show socioeconomic status of sampling sites in relation to microbiological quality of the examined minced meat samples according to their parameters as a bar chart.

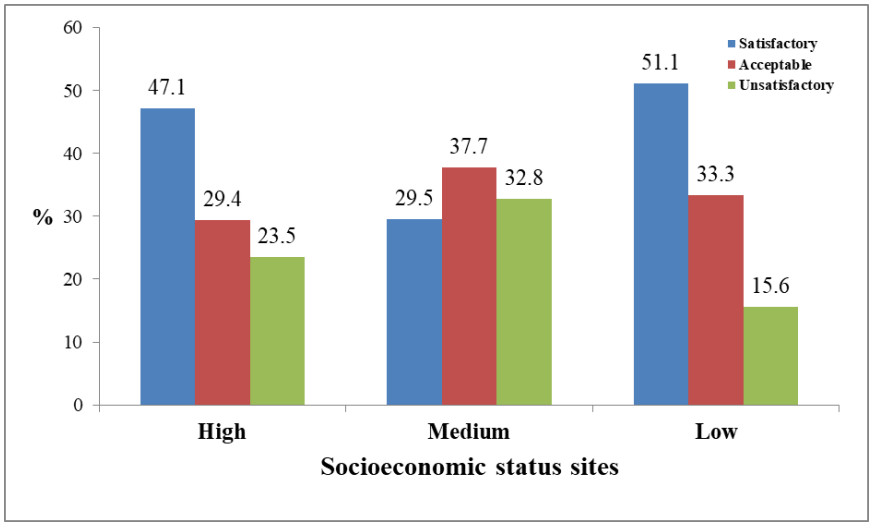

Fig. 1: APC parameter.

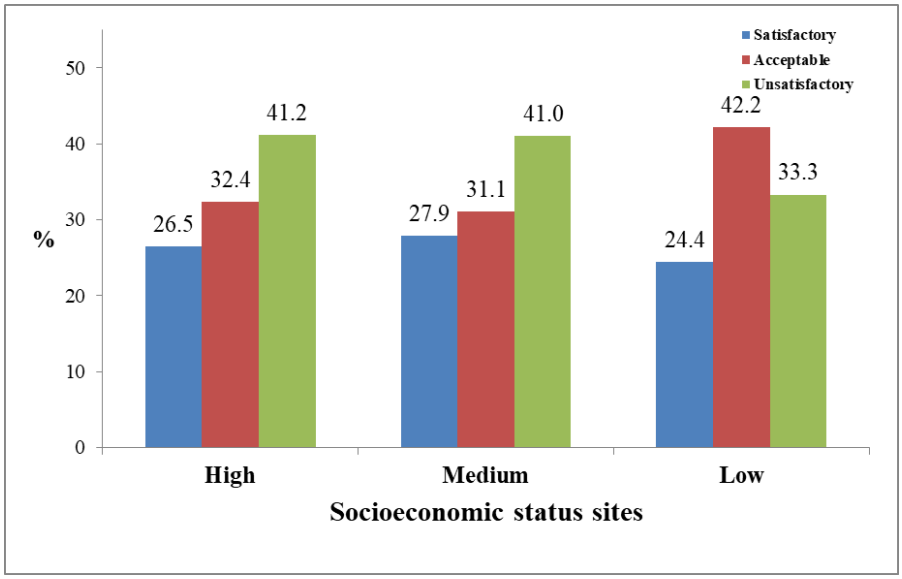

Fig. 2: TCC parameter.

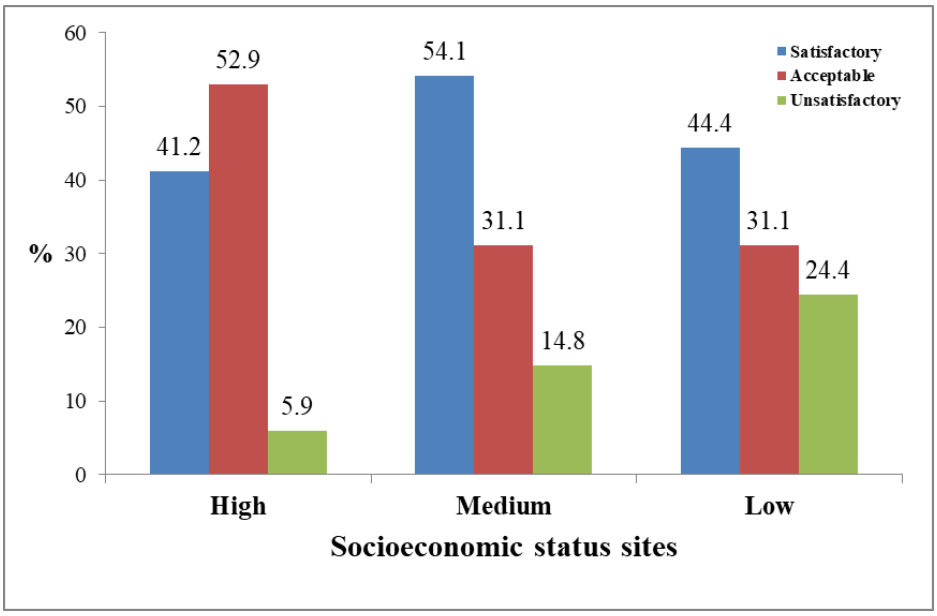

Fig. 3: E. coli count parameter.

It is important to know the hygienic status of collection site. Knowing the source of contamination will be important to establish the controlling system [19]. In the present study, it was surprising to found that according to APC and TCC, the meat samples collected from the lowest SES shops were unsatisfactory in lower percentage when compared to those collected from the higher SES shops. This was the same as recorded by Koro et al [20], who found the APC in minced beef available in high-SES markets was significantly higher compared with that found in low-SES markets. Also Cohen et al [21] found the lowest SES had the lowest values of APC, however they found no change in mean values of fecal coliform in the slaughterhouse, supermarket meat, shop and traditional market.

On the contrary, *E. coli* counts directed more samples as unsatisfactory in the lowest SES shops. Similar results were recorded by Haileselassie et al [18] in Ethiopia. The higher rate of contamination of meat with these organisms is an indication of deplorable state of poor hygienic and sanitary practices employed right from the slaughtering, transportation, butcher shop and processing**.**

Conclusion

The medium socioeconomic status sites had poor hygienic status and the lowest SES shops were unsatisfactory in lower percentage when compared to those collected from the higher SES shops. On the contrary, *E. coli* counts directed more samples as unsatisfactory in the lowest SES shops but in general this study was calculated that the SES sites did not affect statistically the microbiological quality of the examined ground meat samples according to their APC, TCC and *E.coli* count.

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