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BACTERIOLOGICAL QUALITY OF MEALS FROM AN AVIATION KITCHEN (With 3 Tables)

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(Received at 21/6/1990)

الحالة البكتريولوجية للوجبات المعدة بمطبخ إحدى شركات الطيران

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أجرى البحث على خمسين عينة من الوجبات المعدة بمطبخ إحدى شركات الطيران العالمية. وقد مثلت العينات وجبتين أساسيتين وكان عدد العينات في كل وجبة خمس وعشرون وذلك لتحديد الحالة البكتريولوجية. وقد تم تعيين العدد الكلي للميكروبات الهوائية (APC/g) والميكروبات المعوية (Enterobacteriaceae count/g) وميكروبات القولون (MPN/g) وكذا ميكروب الباسيلس سيروبوس في تلك الوجبات. وقد أمكن عزل ميكروب سيتروباكترو فرندياي، انتيروباكترو ايجينز، انتيروباكترو كلواكي، كليبسيلا أوكسيتوكا، كليبسيلانيوني، بروتيس فالجاريس، سهراتيا ليكوفاشينس، وسهراتيا مارسيسينس بنسب مختلفة من هذه الوجبات. هذا ولم يمكن عزل ميكروب الايشريشاكولاي أو السالمونيلا من العينات المختبرة. وقد تم مناقشة الأهمية الاقتصادية للميكروبات المعزولة وكذا الاشتراطات الصحية الواجب توافرها أثناء إنتاج وتخزين وتداول تلك الوجبات.

SUMMARY

Fifty samples of aviation meals prepared in an international kitchen, representing two main meals, 25 each (I and II), were examined for their bacteriological quality. Aerobic plate count, enterobacteriaceae count, MPN of coliforms, *Bacillus cereus* count as well as presence of *E. coli* and *Salmonellae* were investigated. Neither *E. coli* nor *Salmonellae* could be detected. The economic and public health importance of the isolated microorganisms as well as the suggestive control measures for production, handling and storage of meals in aviation kitchens were discussed.

INTRODUCTION

Proper nutrition is identified as one of the essential elements of primary health care. But food has to be both nutritious and wholesome, it has to support health, and not to cause foodborne infections or intoxications through contamination with microorganisms or toxic substances. This applies in particular to the special field of aviation catering too (GORK, 1985a).

In recent years, the increase in airtraffic and mass tourism, has grown into an ever bigger challenge for inflight service. The production of aviation meals is often affected under the conditions of big-sized industrial plants, and outputs of extremely large number of meals per day, meeting the ever more expectations and needs of

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the passengers from all continents as to the sensorial, religious, ethical and hygienic qualities of inflight meals (GORK, 1986b).

Catering is one of the food serving establishments supplying the aircraft with the different types of meals. However, the catering facilities in many countries do not meet required standards from both the technical and hygienic points of view (HEINEMANN, 1986).

Dairy products, eggs and meat are among the main constituents of inflight meals offered for the passengers and crews. In flight catering, the selection of raw foodstuffs, the composition of menu, as well as the preparation of the food has to lead to a quality which by far exceeds standards established for mass catering, though it is somewhat similar.

Outbreaks of foodborne infections and intoxications have been reported associated with inflight meals. Yet, such outbreaks are only rarely published because of their spectacular effects on the public (MUNCE, 1978; KUNSTLER and AHLERT, 1980; WHO, 1983; GORK, 1986a; HASSAN, 1986 and ROBERTS and GILBERT, 1986).

The aim of this study was to assess the bacteriological quality of inflight meals served by an international aviation kitchen in Egypt.

MATERIAL and METHODS

50 samples of meals prepared in an international aviation kitchen, were collected during the period from May to July 1989. Samples represent two main meals, 25 each (I and II).

Meal I is composed of French Omelet with cheese and scallop of veal. While meal II is composed of poached egg, hamburger with tomato concasse.

Samples were collected at the final stage of preparation as near to the time of distribution to the aircraft as possible, and were submitted to the laboratory in the containers in which they would be served.

Collected samples were prepared according to the technique recommended by ICMSF (1978), before they were subjected to the following bacteriological examinations:

- 1- Determination of aerobic plate count/g (APC/g): Using the drop plate technique recommended by ICMSF (1978).
- 2- Determination of total enterobacteriaceae count/g: The drop plate technique was applied using crystal violet bile glucose agar as recommended by GORK (1976).
- 3- Determination of Most Probable Number of Coliforms (MPN/g): The technique recommended by ISO, 1975 was applied.
- 4- Isolation and identification of coliform organisms: Suspected colonies on eosin methylene blue agar plates were isolated, purified and identified according to KRIEG and HOLT (1984).

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- 5- Detection of *E.coli*: The technique recommended by ISO, 1975 was applied.
- 6- Determination of *Bacillus cereus* count/g: For enumeration and isolation of *B.cereus* the technique recommended by HOLBROOK and ANDERSON (1980) was applied using PEMBA medium.
- 7- Detection of *Salmonellae*: The technique recommended by HARVEY and PRICE (1981) was carried out.

RESULTS

Results are recorded in Tables 1, 2 and 3.

Table (1): Statistical analytical results of the examined aviation meals.

	Kind of meal	Positive *		Minimum	Maximum	Mean	S.E.M. *
		No.	%				
APC/g	I	19	76	10^3	5×10^5	4.9×10^4	2.3×10^4
	II	21	84	6×10^2	2×10^4	1.6×10^4	0.78×10^4
Enterobacteriaceae count/g.	I	13	52	2×10^2	10^5	4.7×10^3	3.9×10^3
	II	16	64	2×10^2	6×10^4	3.04×10^3	2.3×10^3
MPN/g	I	13	52	23	5×10^2	80.64	18.85
	II	17	68	21	11×10^2	104	41
<i>Bacillus cereus</i> count/g	I	3	12	10^2	10^3	56.28	39.43
	II	4	16	10^2	3×10^3	175	121

*Positive APC/g = $\geq 2 \times 10^2$

Enterobacteriaceae count/g = $\geq 2 \times 10^2$

MPN/g = ≥ 3

Bacillus cereus count/g = $\geq 10^2$

Table(2): Bacteriological quality of the examined samples based on the standards suggested by Lufthansa service (1986).

	I				II			
	APC/g		Enterobacteriaceae count/g		APC/g		Enterobacteriaceae count/g	
	No.	%	No.	%	No.	%	No.	%
A(Good) $\leq 10^5$	24	96	25	100	24	96	25	100
B(Tolerable) $\leq 5 \times 10^5$	1	4	-	-	1	4	-	-
C(Substandard) $\leq 5 \times 10^6$	-	-	-	-	-	-	-	-
D(Alarming) $> 5 \times 10^6$	-	-	-	-	-	-	-	-

Table(3): Incidence of isolated coliform organisms from examined samples.

	Meal I		Meal II		Total	
	No. of samples	%	No. of samples	%	No. of samples	%
<i>Citrobacter freundii</i>	3	12	1	4	4	8
<i>Enterobacter aerogenes</i>	1	4	1	4	2	4
<i>Enterobacter cloacae</i>	1	4	-	-	1	2
<i>Klebsiella oxytoca</i>	2	8	1	4	3	6
<i>K. pneumoniae</i>	1	4	-	-	1	2
<i>Proteus vulgaris</i>	-	-	4	16	4	8
<i>Serratia liquefaciens</i>	1	4	-	-	1	2
<i>Serratia marcescens</i>	-	-	1	4	1	2

DISCUSSION

It is evident from the results given in table (1) that the mean APC/g was $4.9 \times 10^4 \pm 2.3 \times 10^4$ and $1.6 \times 10^4 \pm 0.78 \times 10^4$ of meal I and meal II respectively. On the other hand, the mean enterobacteriaceae count/g was $4.7 \times 10^3 \pm 3.9 \times 10^3$ and $3.04 \times 10^3 \pm 2.3 \times 10^3$ in the examined samples of aviation meal I and II respectively. Moreover, the given results show that 24% of meal I and 16% of meal II failed to show growth ($< 2 \times 10^2$) over the plate count agar plates, as well as, 48% of meal I and 36% of meal II failed to show growth ($< 2 \times 10^2$) over the crystal violet glucose agar plates by the used techniques.

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According to the quality standards recommended by Lufthansa service in Germany (1986) 95% of examined aviation meal samples I and II are considered "Good" and 4 of both meals are considered "Tolerable" based on their APC/g. On the other hand, all examined aviation meals samples are considered "Good" based on their enterobacteriaceae count/g (Table, 2). The lower counts achieved in this work may be attributed to the selection of good raw materials, application of adequate sanitary measures during different stages of processing and prevention of post-processing contamination. Nearly similar results were recorded by YASSIEN and EL-ESSAWY (1990), while comparatively higher counts were recorded by HASSAN (1986) and ROBERTS and GILBERT (1986).

Results presented in Table (1) reveal that the mean MPN/g of coli-forms was 80.64 ± 18.85 and 104 ± 41 of both meal I and II respectively. It is also evident that 48% and 32% of the examined meals were negative for coliforms. The comparatively higher counts recorded by EL-DALY (1986) and YASSIEN and EL-ESSAWY (1990) may be due to contaminated raw materials, unsatisfactory sanitation, unsuitable time/temperatures conditions during production or storage or a combination of these.

Concerning isolates of public health significance, neither E.coli nor salmonellae could be detected from any of the examined flight meal samples. On the other hand Citrobacter freundii, Enterobacter aerogenes, Enterobacter cloacae, Klebsiella oxytoca, K. pneumoniae, Roteus vulgaris, Serratia liquefaciens and Serratia marcescens could be isolated at different percentages from the examined samples ranging from 2% to 8% (Table 3).

Coliforms other than E. coli persist in soil or on surfaces longer than will E. coli, thus, coliforms do not necessarily indicate faecal contamination (ICMSF, 1978). However, presence of coliforms in ready to eat meals may be indicative of faulty methods of preparation, handling and plant management, which may lead to economic losses through the development of undesirable changes rendering the quality of the products or even its fitness for human consumption.

On the other hand, some of the isolated microorganisms have been implicated in food-illness e.g. Proteus spp, Citrobacter freundii, Enterobacter species and Klebsiella pneumoniae (FRAZIER, 1967; BAILEY & SCOTT, 1974; PYATKIN & KRIVOSHEIN, 1980 and KRIEG & HOLT, 1984).

Bacillus cereus which has been implicated in many cases of food poisoning has been found in 12% and 16% of the examined meals I and II respectively, with a mean value of 56.28 ± 39.43 and 175 ± 121 per gram respectively (Table 1).

Although B.cereus food poisoning occur only when the ingested food contains very large numbers of cells, usually exceeding 10^7 per gram or ml., however storage of moist processed or cooked protein or carbohydrate food under inadequate refrigeration is the essential factor in allowing proliferation of the organism (ICMSF, 1978). The ubiquitous nature of B.cereus, its role in food poisoning and its ability to cause

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a variety of severe infections are well documented (GOEPFERT *et al.*, 1972; DAVIES & WILKINSON, 1973; GILBERT *et al.*, 1974 and TURNBULL *et al.*, 1979).

For food safety and quality assurance in aviation catering plant, measures involved in the Good Manufacturing Practice System suggested by GORK, 1986b are recommended. Moreover, the ten golden rules drawn by (WHO, 1989) for safe food preparation should be followed:

- 1- Choose foods processed for safety.
- 2- Cook food thoroughly.
- 3- Eat cooked food immediately.
- 4- Store cooked food carefully.
- 5- Reheat cooked food thoroughly.
- 6- Avoid contact between raw foods and cooked foods.
- 7- Wash hands repeatedly.
- 8- Keep all kitchen surfaces meticulously clean.
- 9- Protect foods from insects, rodents and other animals.
- 10- Use pure water.

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