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ORIGINAL ARTICLE

Evaluation of selected dishes from the hot area of the Havana Catering Base Business Unit

Evaluación de platos seleccionados en el área caliente de la Unidad Empresarial de Base Catering Habana

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Abstract This study aimed to evaluate the hygienic-sanitary behavior of selected dishes in the hot area of UEB Catering Habana on board aircraft, using a flight simulation. The airline Cuban Aviation Company was chosen due to its high flight frequency and number of services offered. The results of raw materials and finished products from 2005 to 2007 (time zero) were analyzed. During the flight simulation (8-10 hours, 20 °C in a trolley), the dishes were prepared following the current technological process. Physicochemical (pH and moisture) and microbiological (aerobic mesophilic microorganisms, total and fecal coliforms, molds, and yeasts) were determined before and after the simulation on five selected dishes. The results showed that 12.3% of the samples did not meet the established microbiological parameters, with total coliforms, aerobic mesophilic organisms, molds, and yeasts being the main causes of non-compliance. The pH and moisture values, along with the use of sauces, indicated a high risk for microbial growth. None of the five dishes met the established time and showed sanitary non-compliance. The microbiological evaluations suggest that the main problems in the preparation and assembly of the dishes are due to inadequate handling and processing practices.

Keywords hygienic-sanitary behavior, hot catering area, microbiological analysis, flight simulation, food safety.

Resumen Este trabajo tuvo como objetivo evaluar el comportamiento higiénico-sanitario a bordo de aeronaves de platos seleccionados en el área caliente de la UEB Catering Habana, mediante una simulación de vuelo. Se eligió la aerolínea Empresa Cubana de Aviación por su alta frecuencia de vuelos y cantidad de servicios ofertados. Se analizaron los resultados de materias primas y productos terminados de 2005 a 2007 (tiempo cero). Durante la simulación de vuelo (8-10 h, 20 °C en trolley), se elaboraron los platos siguiendo el flujo tecnológico vigente. Se realizaron determinaciones físico-químicas (pH y humedad) y microbiológicas (recuento de microorganismos aerobios mesófilos, coliformes totales y fecales, hongos y levaduras) antes y después de la simulación en cinco platos seleccionados. Los resultados mostraron que el 12,3% de las muestras no cumplió con los parámetros microbiológicos establecidos, siendo los microorganismos coliformes totales, aerobios mesófilos, hongos y levaduras las principales causas de incumplimiento. Los valores de pH y humedad, junto con el uso de salsas, indicaron un alto riesgo para el desarrollo microbiano. Ninguno de los cinco platos cumplió con el tiempo establecido y todos presentaron incumplimientos sanitarios. Las evaluaciones microbiológicas sugieren que los principales problemas en la elaboración y montaje de los platos se deben a inadecuadas prácticas de manipulación y procesamiento.

Palabras clave comportamiento higiénico-sanitario, área caliente de catering, análisis microbiológico, simulación de vuelo, inocuidad alimentaria.

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PUBLIS EDITORIAL

Introduction

Globally, airport catering services are distinguished by their commitment to food hygiene and high food safety for passengers of various airlines (Fróna et al., 2019). Onboard meals are a primary concern for operators, as current customers demand increasingly high-quality products they consume, with food safety being an essential aspect of quality. Providers are viewed as integral entities, and passengers expect every interaction to be pleasant, with impeccable coordination and no room for chance. This situation underscores the importance of ensuring hygienic food preparation in this service, not only to protect the crew's health but also to safeguard that of an increasing number of passengers, preventing the spread of diseases across different regions.

The complex and diverse production processes in air catering, along with the need to ensure food quality, require the implementation of quality control systems that assess critical danger points and establish preventive measures, rather than relying solely on final product analysis, which is linked to costly laboratory studies and potential economic losses (Okpala & Korzeniowska, 2021).

In-flight catering involves the preparation of ready-to-eat meals, which are served as both hot and cold dishes. These services must adhere to strict hygienic control methods. Like in other sectors, these foods are consumed in flight, making it essential to adopt rigorous sanitary measures to prevent Foodborne Illnesses (FBIs). The magnitude of these illnesses not only harms health but also damages the economy, generating significant revenue losses and legal claims, which can damage the company's reputation.

Within the products prepared in air catering, beef, pork, and poultry play a prominent role in both preparation volume and potential risks. Meat, in particular, is one of the raw materials that requires the most care to ensure its sanitary quality so that food derived from it reaches consumers with the appropriate hygiene standards (Alegbeleye et al., 2022; Bajić et al., 2022).

In the specific case of foods prepared for consumption aboard aircraft, safety takes on even greater importance, as any incident during the flight can severely compromise safety. Therefore, air caterings continuously strive to meet hygienic conditions that allow for the preparation of safe foods and ensure that their preservation guarantees they arrive in optimal condition for both passengers and crew. In this context, the present work aims to evaluate the hygienic-sanitary behavior of selected dishes in the hot area during a flight simulation at UEB Catering Habana.

Materials and methods

An airline from Cubacatering was selected based on its frequency of weekly flights and the number of services offered. Given the importance of in-flight meals for passenger satisfaction and competition in the industry, the hot food area was chosen to study the stability of the dishes prepared at UEB Catering Habana. The selection of dishes was based on their susceptibility to spoilage, especially those containing meats such as chicken and fish, which are in high demand in in-flight catering.

A retrospective study was conducted, analyzing results from 2005 to 2007 regarding raw materials and finished products of the selected dishes, obtained from the monthly reports of the National Food Quality Inspection Center (CNICA, Cuba), Food Quality Laboratories (LACAL, Cuba) and Varadero Laboratories (Cuba). The information was organized and classified by year, achieving a consistent relationship during the analyzed period.

To simulate the behavior of the dishes on board, they were prepared in the kitchen and rapidly cooled, reaching temperatures below 10 °C in less than four hours. They were then stored in a refrigerator at temperatures between 0 and 4 °C for 30 hours. Subsequently, the dishes were assembled in trolleys, which were also refrigerated, and samples were taken that were frozen at -10 °C and sent to CNICA for microbiological analysis. Some samples were stored at 20 °C for 8 to 10 hours in a conditioned area to simulate on-board conditions before the analyses.

Physical and chemical quality attributes, such as moisture content (AOAC, 1997) and pH (ISO-2917, 1999) were evaluated immediately after the simulation. Microbiological determinations were carried out according to Cuban standard NC 38-02-07:87, taking two samples per batch. The microbiological analyses included the total count of mesophilic aerobic microorganisms, total coliforms, fecal coliforms, and total yeasts and molds, conducted on the five selected dishes before and after each simulation period. For statistical processing of the results, the mean and standard deviation were calculated.

Results and discussion

An analysis was conducted of the airlines served by Cubacatering S.A., resulting in a nominal list of them. During the period from April 1 to May 10, 2008, hot meal services were offered to 16 airlines, with varying weekly flight frequencies. The number of airlines may change depending on the time of year, commercial commitments, and other factors. The Cuban Aviation Company was identified as the airline with the highest frequency of weekly flights and the largest number of services offered, which led to its selection for this study.

Once the airline was selected, the dishes were chosen from the customer catalog, which is divided into three categories: Club Tropical, Economy, and Crew. Most of the selected dishes belonged to the Club Tropical category due to their greater complexity in preparation and the ingredients used, which made them more susceptible to deterioration, especially due to the sauces. The Club Tropical catalog features ten hot dishes, while the Economy category includes six dishes. From these two categories, five hot dishes were selected for the study due to their high spoilage risk and extensive handling. These dishes include shredded meat with vegetables (carrots, potato balls, and demiglace sauce); chicken supreme with red sauce (salad, spaghetti, tomato sauce, and grated Gouda cheese); smoked loin with criolla sauce and white rice; breaded chicken supreme with congrí rice; and grouper fillet with beans, yellow rice, and broccoli.

The dishes were prepared following the established technological flow, meeting all the required time and temperature parameters for their preparation in the hot area. To ensure that the conditions during the simulation closely resembled commercial conditions, the temperature was measured during storage in the simulation area, with the results presented in Figure 1.

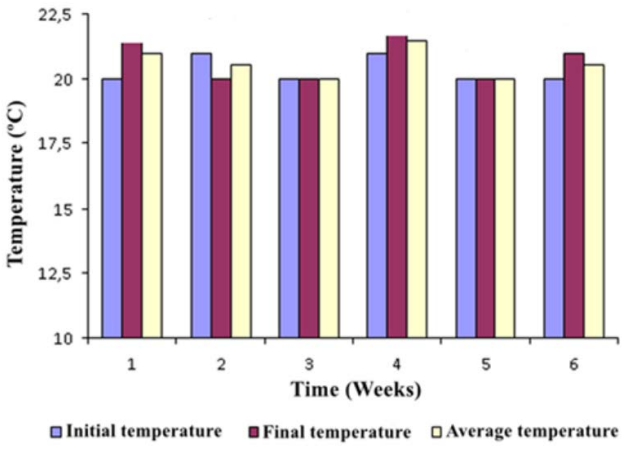

Figure 1. Temperature behavior during the simulation.

During the simulation of sample storage in the conditioned area for the study, the temperature ranged from 20 to 22 °C, values that are representative of flight conditions and align with expectations for a climate-controlled environment. Although continuous temperature recording was not performed during the simulation, the reported values are representative of the process, as there were no interruptions in the electrical supply during that period.

pH control is crucial in the production of food products, as it not only helps monitor transformation processes but also serves as an indicator of hygienic conditions. A change in pH can signal undesirable changes in the product. Additionally, high levels of humidity promote the development of microorganisms. The pH and humidity, along with temperature, are important factors for food preservation.

Physical-chemical analyses of moisture and pH were conducted. These parameters were chosen for their direct connection to maintaining the hygienic stability of food. In general, products with a higher water content and a pH close to neutrality are more susceptible to spoilage, especially by microorganisms. Water, in addition to being an essential component in food, influences its structure and texture, and its interaction with other components determines relative stability during storage. The results of the physical and chemical analyses of the different dishes are shown in Table 1.

Meat has a pH that favors the growth of most microorganisms (Satriawan et al., 2022), making it highly perishable and unstable. However, the analyses were conducted on cooked meats, whose cooking reduces both moisture and the level of contamination, significantly slowing down spoilage. On the other hand, carrots, like many other vegetables, have a high moisture content, as indicated in the table. If cutting surfaces are not adequately disinfected, there could be a risk of contamination, although this risk is partially mitigated by the cooking process, given that it is an industrial product. Potato balls, which also have high moisture, face a similar risk.

The pH of these ingredients does not make them particularly vulnerable to spoilage, but it is also not low enough to ensure safety in case of contamination after cooking, for example, during plate assembly. It is important to note that this dish contains shredded meat with vegetables, which, although cooked, remains susceptible to spoilage. The addition of the demi-glace sauce could increase these risks.

The pH and moisture values found for this dish do not indicate spoilage risks. Additionally, several industrial products are used in its preparation, such as vegetable medley, Gouda cheese, and tomato sauce. The red sauce is prepared in advance at the plant, so it does not interfere with the cooking of the dish. In the case of Gouda cheese, the reported pH values range from 5.28 to 5.32 (Méndez & Ramírez, 2020), indicating that it is not a highly perishable product. However, being grated increases the likelihood of spoilage.

Chicken meat is commonly implicated in outbreaks and foodborne illnesses. The values of the analyzed dishes do not suggest quality issues. In the case of breaded chicken, like other cooked meats, the microbial load is reduced due to the cooking process. This dish is simple, and its moisture and pH values, like those of the chicken, do not indicate alterations or spoilage in its components, although it includes mojo criollo sauce, which may increase its susceptibility to spoilage.

The biochemical changes that fish undergo lead to different stages of spoilage and degrees of freshness, which are important for the acceptance of fish quality when used as raw material for storage or direct human consumption. The

Table 1. Physical and chemical analysis of the evaluated dishes

Dish	Component	Humidity	pH
Shredded meat, tropical class, dinner, cycle 2	Beef	61.6 (1.0)	5.59 (0.01)
	Carrot	90.1 (2.0)	5.1 (0.1)
	Potato ball	83.87 (0.04)	5.29 (0.01)
Chicken supreme, tropical class, dinner, cycle 1	Chicken	64 (1.0)	6.3 (0.1)
	Vegetables	82.1 (0.3)	5.74 (0.01
	Pasta	52.7 (0.1)	5.43 (0.02)
Breaded chicken supreme, economic class, return dinner, single cycle	Moro rice	50.27 (0.2)	6.23 (0.11)
	Breaded chicken supreme	55.69 (0.01)	7.03 (0.01)
Smoked loin, economic class, return dinner, single cycle	White rice	50.3 (1.0)	6.2 (0.4)
	Smoked loin	61.1 (0.2)	6.0 (0.2)
Grouper fillet, tropical class, dinner, cycle 1	Yellow rice	52.9 (1.0)	6.91 (0.02)
	Fish fillet	62.6 (4.0)	7.16 (0.08)
	Vegetable (Broccoli)	86.2 (2.0)	6.66 (0.04)

pH of fish is higher than that of beef, making it more susceptible to microbial attack, thus increasing its chances of contamination. Of all the analyzed dishes, this one has the highest overall pH.

In general, the results of the physical-chemical analyses confirm that the selection of these dishes was appropriate, as all present elements of spoilage risk from microorganisms. The determinations of the dishes were conducted in duplicate and showed values exceeding the established maximum limits, indicating that these dishes do not have good microbiological quality. It cannot be assured that the meat raw materials that make up the dishes meet ideal sanitary conditions at the plant; however, it is important to note that the microbial load present from the moment of slaughter has a significant impact on the microbiological quality of the meats used in the industry.

The microbiological analyses (Table 2) performed included the total count of mesophilic aerobic microorganisms, total and fecal coliforms, as well as yeasts and molds. The presence of microorganisms in food is critical because food products are not sterile and can naturally support microbial growth, which may pose significant health risks to consumers.

The microbiological results for shredded meat indicated that not all values were within the established limits (NC 38-02-07, 1987). The counts of mesophilic aerobic microorganisms and total coliforms exceeded the maximum limit at time zero. The vegetables used for shredding the meat, which are handled in a process with high chances of carelessness, pose a risk. The chicken supreme also showed results outside the limits, both in mesophilic aerobic microorganisms and in total coliforms, yeasts, and molds, in both the values reported by CNICA at time zero and those conducted at the laboratories of the Pharmacy and Food Institute. The presence of red sauce may be responsible for these results. In the case of the breaded chicken supreme, values outside the limits were recorded only for yeasts, due precisely to the breading.

The smoked loin exhibited the highest levels of total coliforms, likely attributed to improper handling (Martin et al., 2016). The addition of mojo criollo sauce may also increase these risks. The fish with broccoli showed values outside the limits for total coliforms, yeasts, and molds, which aligns with the nature of these products and the high pH found in this dish.

Discrepancies were observed between the analyses conducted by CNICA and those performed in our laboratory for the shredded meat and the chicken supreme with garnish. This can be explained by the difference in analytical units and suggests the need to increase the number of samples in future studies.

However, confirmatory tests for fecal coliforms in all studied dishes were negative at both, time zero and after the simulation. This indicates that, although it is necessary to implement educational measures for the staff, there are no signs of serious violations of hygiene procedures, such as failing to wash hands after using the restroom.

Conclusions

In conclusion, the analysis of the microbiological quality of the dishes prepared at the entity and their raw materials during the period 2005-2007 revealed that 12.3% of the samples did not meet the established microbiological parameters, with most non-compliance attributed to the presence of total coliforms, mesophilic aerobes, yeasts, and molds. Additionally, the values of pH and moisture content, along with

Table 2. Microbiological results of the dishes

Food	Batch	Mesophilic aerobes		Total coliforms		Fungi		Yeast	
		0 h	42 h	0 h	42 h	0 h	42 h	0 h	42 h
Shredded meat	1	$3x10^6$	$2.52x10^6$	$>1.5x10^3$	$\leq 1x10^2$	NP	<1x10	NP	$<1x10^2$
		$3x10^6$	$2.64x10^5$	$>1.5x10^3$	$\leq 1x10^2$		<1x10		$<1x10^2$
		$3x10^6$	$2.24x10^5$	$>1.5x10^3$	$\leq 1x10^2$		<1x10		$<1x10^2$
		$3x10^6$	$2.76x10^4$	$>1.5x10^3$	$\leq 1x10^2$		<1x10		$<1x10^2$
	2	$5x10^3$	$1.78x10^5$	<1x10	$\leq 1x10^2$	NP	<1x10	NP	$<1x10^2$
		$5x10^3$	$2.16x10^5$	<1x10	$\leq 1x10^2$		<1x10		$<1x10^2$
		$5x10^3$	$1.84x10^3$	<1x10	$\leq 1x10^2$		<1x10		$5.0x10^2$
		$5x10^3$	$1.92x10^3$	<1x10	$\leq 1x10^2$		<1x10		$1.3x10^3$
Chicken supreme with garnish	1	$3.6x10^6$	$2.16x10^3$	$1.5x10^3$	1x102	NP	<1x10	NP	$3.4x10^2$
		$3.6x10^6$	$1.92x10^3$	$1.5x10^3$	$<1x10^2$		<1x10		$2x10^2$
		$3.6x10^6$	$2.88x10^5$	$1.5x10^3$	$1.28x10^3$		3x10		$1.5x10^3$
		$3.6x10^6$	$2.88x10^4$	$1.5x10^3$	$1.36x10^3$		$1.5x10^3$		$5.0x10^2$
	2	$3x10^6$	$1.76x10^4$	$3.6x10^2$	$1.08x10^3$	NP	$1.7x10^3$	NP	$<1x10^2$
		$3x10^6$	$1.80x10^4$	$3.6x10^2$	$2.04x10^3$		$4x10^3$		$<1x10^2$
		$3x10^6$	$3.24x10^4$	$3.6x10^2$	$<1x10^2$		$6.4x10^2$		$<1x10^2$
		$3x10^6$	$3.1x10^4$	$3.6x10^2$	$1.52x10^3$		<1x10		$<1x10^2$
Breaded chicken supreme	1	<1x10	$1.76x10^3$	<1x10	$1.48x10^4$	NP	<1x10	NP	$<1x10^2$
		<1x10	$2.20x10^3$	<1x10	$8.80x10^3$		<1x10		$<1x10^2$
		<1x10	$1.28x10^3$	<1x10	$1.16x10^3$		<1x10		$<1x10^2$
		<1x10	$1.16x10^3$	<1x10	$9.20x10^4$		<1x10		$<1x10^2$
	2	<1x10	$1.18x10^3$	<1x10	$7.6x10^2$	NP	<1x10	NP	$<1x10^2$
		<1x10	$1.00x10^3$	<1x10	$8.9x10^2$		<1x10		$<1x10^2$
		<1x10	$7.50x10^3$	<1x10	$1.2x10^3$		<1x10		$<1x10^2$
		<1x10	$1.28x10^3$	<1x10	$1.08x10^3$		<1x10		$<1x10^2$
Smoked loin with its garnish	1	<1x10	$1.20x10^3$	<1x10	$1.28x10^2$	NP	<1x10	NP	$<1x10^2$
		<1x10	$1.36x10^3$	<1x10	$1.04x10^2$		<1x10		$<1x10^2$
		<1x10	$1.52x10^5$	<1x10	$1.12x10^2$		<1x10		$<1x10^2$
		<1x10	$1.36x10^3$	<1x10	$7.2x10^3$		<1x10		$<1x10^2$
	2	<1x10	$2.56x10^3$	<1x10	$<1x10^2$	NP	<1x10	NP	$<1x10^2$
		<1x10	$8.4x10^3$	<1x10	$<1x10^2$		<1x10		$<1x10^2$
		<1x10	$9.6x10^3$	<1x10	$<1x10^2$		<1x10		$<1x10^2$
		<1x10	$7.6x10^3$	<1x10	$<1x10^2$		<1x10		$<1x10^2$
Grouper fillet with its garnish	1	$1.44x10^3$	$1.60x10^5$	$4.4x10^2$	$2.00x10^2$	>1x10	<1x10	$6.4x10^2$	$9.6x10^2$
		$1.88x10^3$	$1.36x10^5$	$<1x10^2$	$1.96x10^2$	>1x10	<1x10	$<1x10^2$	$8.4x10^2$
		$1.24x10^3$	$1.20x10^5$	$<1x10^2$	$1.86x10^2$	>1x10	<1x10	$<1x10^2$	$6.4x10^2$
		$1.72x10^3$	$1.44x10^5$	$<1x10^2$	$1.40x10^2$	>1x10	<1x10	$1.44x10^3$	$3.9x10^2$
	2	$2.4x10^3$	$9.6x10^4$	$5.4x10^2$	$1.44x10^3$	>1x10	<1x10	$5.6x10^2$	$<1x10^2$
		$2.12x10^3$	$8.8x10^4$	$<1x10^2$	$1.08x10^3$	>1x10	<1x10	$<1x10^2$	$<1x10^2$
		$1.24x10^3$	$8.0x10^4$	$<1x10^2$	$2.52x10^3$	>1x10	<1x10	$<1x10^2$	$6.5x10^2$
		$1.52x10^3$	$3.8x10^4$	$<1x10^2$	$2.40x10^3$	>1x10	<1x10	$5.2x10^2$	$4.6x10^2$

NP: Not performed.

the use of sauces in the preparation of the dishes, suggest a high risk for microbial development. None of the five studied dishes met the established time, demonstrating sanitary non-compliance both, before and after the simulation. These results indicate that the main problems in the preparation and assembly of the dishes are related to inadequate handling and processing.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Author contributions

Evelin M. Chillagana, Dayanna E. Veloz and Franklin A. Molina: Conceptualization, data curation, formal analysis, investigation, methodology, supervision, validation, visualization, drafting the original manuscript and writing, review, and editing.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Statement on the use of AI

The authors acknowledge the use of generative AI and AI-assisted technologies to improve the readability and clarity of the article.

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