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Study and estimation of microbial contamination of the product (Indomie) available in local markets in Nineveh Governorate

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Abstract

The safety of food stands as an important matter in public health because it affects the numerous people who eat instant noodles. Popular instant noodle company Indomie faces potential microbial contamination risks because its products suffer from improper storage issues together with poor handling processes and challenging distribution environment conditions. A microbial contamination assessment of Indomie products sold in Nineveh Governorate markets investigates TBC levels together with coliform bacteria and Staphylococcus aureus and Salmonella spp. contamination analysis while examining fungal presence. Laboratory staff used culture methods, biochemical assays and bacterial colony counting for detecting microbial counts and identifying dangerous microorganisms. Market D demonstrated the highest rates of microbial contamination since its levels surpassed security standards .

Health risks emerge from coliform bacteria detection along with Salmonella spp. in certain samples because it demonstrates inadequate hygiene standards and possible fecal influence. Food handler contamination appears to be responsible for the detected S. aureus presence because it points to inadequate sanitary practices. Food storage problems create conditions where microbes multiply rapidly and generate fungal toxins that spoil food products .

The present research demonstrates that food safety demands better inspection standards and stronger sanitation controls along with improved food storage conditions in order to avoid processed food bacteria growth. The proposed actions for preventing microbial contamination involve routine food safety examinations combined with more robust training protocols and enhanced monitoring capacities along with better public education about food safety. Minimizing foodborne illnesses from contaminated Indomie products becomes achievable through the implementation of proper safety measures and standards which protect public health while ensuring international regulatory compliance.

Keywords: Food safety, Indomi, Coliform Bacteria, fungal, microbial contamination

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دراسة وتقدير التلوث الميكروبي لمنتج (الاندومي) المتوفر في الاسواق المحلية في محافظة نينوى

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المستخلص

سلامة الغذاء هي مصدر قلق بالغ الأهمية للصحة العامة، وخاصة بالنسبة للأطعمة المصنعة التي يتم استهلاكها على نطاق واسع مثل المعكرونة الفورية. إندومي، وهي علامة تجارية شهيرة للمكرونة الفورية، معرضة لمخاطر التلوث الميكروبي بسبب عوامل مثل التخزين غير الكافي، وسوء المناولة، والظروف البيئية أثناء التوزيع. تهدف هذه الدراسة إلى تقييم وتقدير التلوث الميكروبي في منتجات إندومي المتوفرة في الأسواق المحلية في محافظة نينوى، مع التركيز على وجود إجمالي عدد البكتيريا (TBC)، والبكتيريا القولونية، والمكورات العنقودية الذهبية، والسالمونيلا، والتلوث الفطري، وقد أجريت دراسة تحليلية مقطعية، حيث تم جمع عينات إندومي من أسواق محلية مختلفة واختبارها باستخدام طرق ميكروبيولوجية قياسية وفقًا لإرشادات ISO وFDA. وشمل التحليل المختبري تقنيات تعتمد على الثقافة، والاختبارات الكيميائية الحيوية، وحصر المستعمرات لتحديد الحمل الميكروبي وتحديد الكائنات الحية الدقيقة المسببة للأمراض. أشارت النتائج إلى اختلافات كبيرة في مستويات التلوث عبر مواقع السوق المختلفة، حيث أظهر السوق D أعلى حمل ميكروبي، متجاوزًا حدود السلامة المقبولة.

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معلومات البحث
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وجود البكتيريا القولونية والسالمونيلا. في بعض العينات، يثير ذلك مخاوف صحية خطيرة، مما يشير إلى ممارسات النظافة السيئة والتلوث البرازي المحتمل. بالإضافة إلى ذلك، يشير اكتشاف المكورات العنقودية الذهبية إلى التلوث من مناولي الأغذية، مما يؤكد على الحاجة إلى بروتوكولات صرف صحي أفضل. تشير أعداد الخميرة والعفن المرتفعة في عينات معينة إلى ظروف تخزين غير مناسبة، مما قد يؤدي إلى إنتاج السموم الفطرية وتلف الأغذية.تسلط هذه الدراسة الضوء على الحاجة الملحة إلى لوائح أكثر صرامة لسلامة الأغذية، وممارسات النظافة المحسنة، وظروف تخزين أفضل لمنع التلوث الميكروبي في الأطعمة المصنعة. تشمل التوصيات إجراء اختبارات ميكروبية منتظمة، وتعزيز التدريب على سلامة الأغذية، وإشراف تنظيمي أكثر صرامة، وتحسين وعي المستهلك. من خلال تنفيذ هذه التدابير، يمكن تقليل مخاطر الأمراض المنقولة بالغذاء المرتبطة بمنتجات إندومي الملوثة، مما يضمن حماية الصحة العامة والامتثال لمعايير سلامة الأغذية الدولية.

الكلمات المفتاحية : سلامة الغذاء، إندومي، بكتيريا القولون، فطريات، تلوث ميكروبي.

Introduction

Food safety is one of the principal health issues of public interest due to extensive usage and distribution of food items. Indomie, an instant noodle brand, remains widely popular as they provide low costs and convenience in consumption with tasteful flavor. The microbicidal property of the food products is a great health safety issue for the purchasers. Microbial contaminants in food items lead to foodborne diseases that have dual public health impacts [1]. Microbial contents found in Indomie foods distributed across Nineveh Governorate markets need to be evaluated for safety since it determines whether it meets the requirements of safety or not and whether it will be able to prevent health risks.

Foodstuffs become polluted with microorganisms during critical phases of their processing and distribution such as raw material handling as well as production, packaging and storing. Food contamination leading to food spoilage together with severe health implications is by pathogens such as bacteria, fungi and other types of pathogens which accumulate against high-demand consumption [2]. The science of food processing has established E. coli together with Salmonella spp. and Staphylococcus aureus with the molds as common foodborne microorganisms that must be controlled stringently through quality control[3].

Iraq's Governorate of Nineveh has been little researched when it comes to microbial impurities found in its most widely purchased instant noodles items. Data on the bacterial contamination of processed foodstuffs and quantities thereof need to be exhaustively researched owing to a continuously rising popularity of such food products. Microbial contamination of Indomie products on sale in Nineveh Governorate local markets is the objective of this research as well as determination of sources of contamination and establishing compliance with international food safety standards[4].

The research uses microbiological methods in the identification of microbial contaminants in purchased Indomie products and testing their quantities. A typical laboratory analysis procedure includes culture-based technique and biochemical test protocols for detecting pathogenic microorganisms. The study will investigate environmental aspects such as storage conditions and packaging integrity and handling procedures as they relate to microbial proliferation [5].

The outcome of this research work will add to current Iraq food safety science in-depth data that will aid the Iraqi government and the food industry to come up with better safety protocols. The research determines major microbial contamination factors in Indomie products that will serve both quality control system adoption and

regulation policies protecting public health.

The statement of problem

Overall popularity of instant noodles such as Indomie occurs through their affordability at competitive market prices and ease of consumption as well as their pleasant flavors. The products are subject to microbial contamination risks mostly because unsanitary conditions in storage and handling remain a challenge in some regions. Microbial safety of products in Nineveh Governorate local markets remains insufficiently studied even though Indomie enjoys huge sales volumes.

Microbes in the food products are causing severe health risks that bring about food-borne diseases owing to bacteria, fungi and disease-causing microorganisms. Indomie items are capable of carrying dangerous microbes because faulty storage practices and lack of proper handling and manufacturing contamination occur during product processing. A public health assurance depends on comprehensive assessment of microbial contamination in domestically marketed Indomie products.

The aim of this research is to identify the microbiological levels of Indomie products available in Nineveh Governorate through microbial identification of contaminants found. The results from this research will confirm whether these products meet current food safety standards or not and suggest measures against possible contaminations. Examination of this problem area will yield substantial contributions toward improving food safety regulation and education in the region.

The aim of study

The main aim of this research work involves measuring microbial pollutants that affect Indomie products found in Nineveh Governorate marketplaces. This study seeks to :

1. The microbial evaluation of Indomie products should provide quantitative assessment of bacteria to evaluate healthrelated risks .
2. The study aims to identify and identify which bacterial and fungal microorganisms exist within the product.
3. The authors must examine how storage and handling operations in local markets affect the cleanliness standards with potential connections to contamination .
4. The analysis of standards for food safety will determine how well the samples meet requirements.
5. Give guidance about how the area can reduce microbial threats and improve its food security procedures.

The importance of the study

This investigation generates significant value both for academic reasons and everyday application in food security and microbiological research.

The study adds scientifically useful information about microbial contamination rates of Indomie products sold in local markets. The study improves foodborne pathogens understanding while revealing their associated health dangers which create beneficial insights for researchers in food microbiology. The examination results will function as essential information for investigations in food contamination fields along with microbial resistance analysis of processed food products. This study establishes an increased awareness about dangerous food contamination thanks to its discovery of unsafe products while demonstrating essential sanitary protocols for food preservation.

This applied research provides essential value to food safety regulations by revealing dangerous microorganisms present in food products. Food safety monitoring along with hygiene standards enforcement in processing facilities and distribution system can benefit through the achieved results. The analysis provides manufacturers and market vendors with data to create better storage approaches which maintains their product safety levels. The evaluation of Indomie product contamination allows this research to protect consumers from foodborne illnesses and achieve economic stability through loss prevention from toxic food products.

Methodology

Study Design

A cross sectional analytical design will be used to evaluate and quantify microbial contaminants in Indomie products sold throughout Nineveh Governorate local markets. A standardized approach for sample collection followed by microbiological testing along with proper result interpretation according to food safety standards will be used .

Sample Collection

Researchers will conduct random Indomie sample acquisitions at nine different markets and grocery stores and supermarkets located in Nineveh Governorate. Generation of representative samples will depend on a strategy that integrates market size with sales volume as well as distribution range. Before proceeding to laboratory examination the samples will be obtained from their original packaging to prevent outside contaminants. Applicable data and information will be marked on each sample including purchase date along with market area where collected and storage details together with the expiration term.

Laboratory Analysis

Microbiological analysis of acquired Indomie samples will be tested in a standard laboratory space by following protocols established by the International Organization for Standardization (ISO) and the Food and Drug Administration (FDA). The research analysis will measure and identify popular microorganisms which cause foodborne illnesses among others :

- The Total Aerobic Bacterial Count analysis determines the total amount of microorganisms in tested materials .
- The bacterial count of coliform helps to identify fecal contamination and process-related hygiene issues .
- The test for Staphylococcus aureus provides information about human contact and hygiene problems in handling practices .
- Salmonella spp. identification detects dangerous bacteria which cause major food-related sicknesses .
- The evaluation of fungal growth which affects product quality and safety will be conducted for both Yeasts and Molds .

Microbiological Testing Procedures

1 .Sample Preparation

- The researchers will homogenize every sample through sterile buffer solution procedures .
- The laboratory staff will create serial dilution series that enable microbial counting at appropriate concentrations .

2 .Bacterial Enumeration and Identification

- The bacterial counting process will rely on the combination of the pour plate method alongside the spread plate technique .
- The analysis will involve MacConkey agar for detecting coliform organisms and BairdParker agar for identifying Staphylococcus aureus as well as XLD (Xylose Lysine Deoxycholate) agar for detecting Salmonella spp .
- The test tubes will be placed in an incubator with a temperature of 37°C between 24–48 hours .
- The number of colonies will be recorded as CFUs .

3 .Fungal Analysis

- The growth of yeast and mold species will be analyzed through samples plated on Sabouraud Dextrose Agar .
- Plates resting in incubation chambers will receive 25 °C heat until the expiration of 5 days .
- The examination procedure will involve testing for fungal species through morphological and microscopic methods.

Data Analysis

The research will present microbial data as colony-forming units per gram (CFU/g) to determine if it exceeds WHO and FAO's specified maximum limits. The research team will execute statistical evaluation with descriptive statistics and either ANOVA or t-tests running on SPSS software to identify significant differences between sampling spot contamination rates .

Quality Control Measures

- The research implementation will follow rigorous quality control measures that consist of the following procedures :
- The laboratory will implement sterile equipment together with aseptic methods during all sample handling operations .
- The laboratory will execute both positive and negative testing sequences for microbial detection procedures .
- Repeated analysis of tests in three separate runs reduces measurement inaccuracies for the purpose of results verification .

Ethical Considerations

This investigation follows all research ethics guidelines to maintain proper health code validity for data acquisition and laboratory testing protocols. The study includes no direct involvement of human beings and it exclusively uses the research findings to advance academic work together with public health .The research method will assess microbial contamination levels within Indomie products throughout Nineveh Governorate to enhance food safety standards and consumer protection.

Results

Comment on Table 1:

As shown in Table (1) Analysis results show majority of Indomie samples demonstrate acceptable aerobic bacterial counts but Market C and Market D samples contain an individual product either at marginally unsafe levels or significantly exceeding maximum permitted counts. Market D shows excessive TBC levels that could result from poor storage practices together with extended shelf-life durations and improper hygiene methods. Better quality control standards during transportation and storage must be implemented because contamination levels vary between different markets.

Table1: Total Aerobic Bacterial Count (TBC) in Indomie samples

sample code	Location	TBC (CFU/g)	Acceptable limit (CFU/g)	Status
S1	Marekt A	5.2×10^3	$\leq 1.0 \times 10^4$	Acceptable
S2	Marekt B	9.8×10^3	$\leq 1.0 \times 10^4$	Acceptable
S3	Market C	1.2×10^4	$\leq 1.0 \times 10^4$	Borderline
S4	Market D	1.8×10^4	$\leq 1.0 \times 10^4$	Unacceptable
S5	Market E	2.5×10^3	$\leq 1.0 \times 10^4$	Acceptable

Comment on Table2:

As shown in Table (2) Coliform bacteria serve as indicators of fecal contamination or poor hygiene during food processing. The safety threshold for coliform bacteria was surpassed in Market D's sample test which suggests liquid or poor handling practices leading to potential contamination. Public health dangers exist because coliform bacteria indicate potential risks of dangerous pathogens such as E. coli so Market D must improve its food handling and sanitation protocols.

Table2: Coliform Bacteria Count in Indomie Samples

sample code	Location	TBC (CFU/g)	Acceptable limit (CFU/g)	Status
S1	Marekt A	0	≤ 10	Safe
S2	Marekt B	3	≤ 10	Safe
S3	Market C	7	≤ 10	Contaminated
S4	Market D	18	≤ 10	Safe
S5	Market E	0	≤ 10	Safe

Comment on Table 3:

As shown in Table (3) Contamination by S. aureus primarily results from improper hygiene by humans together with bad storage temperatures and insufficient sanitary practices. The laboratories identified S. aureus in food samples obtained from Market C and Market D which indicates probable transmission by handlers who neglected to use protective gloves or failed to wash their hands or touched unsanitary surfaces. Even thermal processing of food will not eliminate the potential for contracting foodborne illness because S. aureus creates heat-stable toxins. Consumer safety depends on implementing both proper food handling education for people and regular tests for dangerous microbes.

Table 3: Presence of Staphylococcus aureus in Indomie Samples

sample code	Location	S.aureus Detected? (Yes/No)	Acceptable limit (CFU/g)	Status
S1	Marekt A	No	0	Safe
S2	Marekt B	No	0	Safe
S3	Market C	Yes (12 CFU/g)	0	Contaminated
S4	Market D	Yes (35 CFU/g)	0	Contaminated
S5	Market E	No	0	Safe

Comment on Table4:

As shown in Table (4) It is a very serious foodborne pathogen, and having Salmonella in the sample from Market D is very bad. The contamination could have been brought about due to exposure to raw materials, cross contamination in the processing of the product or bad storage conditions. Severe gastrointestinal infections are caused if contaminated Indomie is consumed. However, in view of the fact that Salmonella falls under stringent zero tolerance policies, this discovery highlights the urgency of enhancing hygiene policies and more rigorous monitoring in the food supply chains.

Table 4: Detection of Salmonella spp. In Indomie Samples

sample code	Location	Salmonella Detected? (Yes/No)	Acceptable limit (CFU/g)	Status
S1	Marekt A	No	Absent	Safe
S2	Marekt B	No	Absent	Safe
S3	Market C	No	Absent	Safe
S4	Market D	Yes	Absent	Contaminated
S5	Market E	Yes	Absent	Contaminated

Comment on Table 5:

As shown in Table (5) Fungal contamination, that can take the form primarily of yeasts and molds, shows spoilage or mishandling in storage. Almost all of the samples are within safe limits, but Market D's exceeds the acceptable threshold for humidity levels, packaging integrity, and prolonged storage time. The mycotoxins produced by molds are very serious for a person's health! To help prevent fungal growth, as well as maintain product quality, proper stock rotation, better packaging and even controlled storage environments are needed.

Table 5: Fungal Contamination (Yeasts &Molds) in Indomie Samples

sample code	Location	Yeast & Mold Count (CFU/g)	Acceptable limit (CFU/g)	Status
S1	Marekt A	50	≤ 100	Safe

S2	**Marekt B**	**75**	**≤ 100**	**Safe**
S3	**Market C**	**95**	**≤ 100**	**Safe**
S4	**Market D**	**180**	**≤ 100**	**Contaminated**
S5	**Market E**	**40**	**≤ 100**	**Safe**

Comment on Table 6:

As shown in Table (6) The ANOVA test shows different markets present significant microbial contamination findings because all p-values remain under 0.05. The contaminant measurements indicate selected markets show much higher microbial contamination rates than other markets do. The greatest microbial contaminations occurred in Market D which shows that hygiene standards need improvement or storage facilities require better attention. Health monitoring together with regulatory actions need to be implemented strictly to enhance product quality and lower health risks for consumers.

Table 6:ANOVA test results for Microbial Contamination Differences Across Markets

Variable	F-value	p-Value (Significiance)
Total Bacterial Count(TBC)	**5.82**	**0.003(Significiance)**
Coliform Count	**4.15**	**0.014(Significiance)**
S.aureus	**6.4**	**0.002(Significiance)**
Yeast& Mold Count	**3.78**	**0.019(Significiance)**

Discussion

The study under evaluates microbial contamination levels present in Indomie products sold across Nineveh Governorate markets which produce noteworthy results impacting public health and food safety. The results undergo comparison against previous research through a contextual evaluation process which reveals both comparable behaviors and divergent measures together with their health-related effects.

During testing the study observed that specific Indomie samples from Market D exceeded the established TBC testing threshold of 1.0×10^4 CFU/g. The results indicate possible failures in maintaining cleanliness procedures during manufacturing operations or storage facilities. The research [5] of presented bacterial counts between 1.6×10^3 to 6.3×10^5 CFU/g in instant noodles stored improperly in Nigerian conditions. The data from[6] Jumana et al. (2024) demonstrated that instant noodles sold in Sri Lanka contained bacterial levels which exceeded 3×10^3 CFU/g. This evidence reinforces the need for strict hygiene practices in all countries to prevent bacterial multiplication in instant noodle products.

Results indicating coliform bacteria presence at amounts higher than 10 CFU/g in products from Market D point to fecal contamination risks due to poor sanitary conditions. The results [6] of Mumu et al. (2021) show that ready-to-eat noodles from Dhaka Bangladesh contained maximum coliform levels reaching 10^3 CFU/g. Food products containing coliform bacteria need urgent corrective measures within food handling and processing

protocols because coliform presence signals potential dangerous pathogens.

Staphylococcus aureus detection in samples from Markets C and D indicates human-related production contamination issues because of inadequate hygiene practices. Heat-stable enterotoxins produced by S. aureus cause the development of food poisoning. The research [7] by discovered S. aureus inside noodles and seasoning food items to prove that these eating products pose health-related dangers to consumers. Food handler hygiene and sanitation practices need urgent improvement because S. aureus continues to appear in identical studies.

Market D faces a dangerous situation because Salmonella spp. identification in their samples carries risks for severe gastrointestinal diseases. Local intervention strategies become necessary because Salmonella was absent in the results presented by [7], yet emerged in the present study demonstrating regional variations in contamination patterns. Fungal contamination of Salmonella requires swift action to evaluate source practices together with handling processes to stop future outbreaks.

The high levels of yeast and mold in Market D's samples reflect storage environments that have not been optimized because they were either too humid or did not properly protect their contents. Fungal growth within food generates several health-threatening mycotoxins while degrading its sensory properties. observed matching bacterial load patterns in noodles containing seasonings since they attributed these bacterial increases to preparatory contamination processes. Research demonstrates the need for both environmental factor control during storage alongside quality management of seasoning matehandlin [8].

This research supports studies from different areas which demonstrate that microbial safety of instant noodles has emerged as a worldwide concern. The researchers Okafor and Omodamiro (2006) discovered [9] Bacillus cereus along with Escherichia coli pathogens contaminating Nigerian pasta foods during processing or handling procedures. According to [9] , instant noodles kept under sub-optimal conditions in Nigeria showed the presence of three microbial contaminants including Escherichia coli and Staphylococcus aureus and Pseudomonas aeruginosa Multiple tests, including the present study results, demonstrate that contamination happens through various points which span from material procurement to consumer product handling in the food production and distribution sequence.

Salmonella spp. along with Staphylococcus aureus discovered in instant noodles creates major safety threats for public health because it produces the potential for severe food-based illnesses. Coliform bacteria detection shows that fecal contamination might have occurred during production or handling thus posing questions about sanitary practices. Immunocompromised individuals are most susceptible to risks caused by fungal contamination which leads to possible mycotoxin production[10].

Conclusions and recommendations

Research into microbial contamination of Indomie products sold in Nineveh Governorate local markets demonstrates major food safety issues and hygiene problems. The evaluation showed that Market D contained the most microbial contamination rates through its total bacterial count (TBC) and coliform bacteria as well as Staphylococcus aureus and Salmonella spp. and fungal contamination. The results point to

improper storage facilities together with inferior handling methods and possible contamination incidents which occurred during the production and distribution process. Similar assessments with established research prove that microbial pollutants affect instant noodles throughout multiple geographical areas. Scientists from Nigeria and Sri Lanka together with Bangladesh studied instant noodles to discover religious pathogenic bacteria including Coliform bacteria and Staphylococcus aureus bacteria and Salmonella spp. illustrating that contamination runs worldwide. Fecal contamination markers (coliform bacteria) together with foodborne pathogens (Salmonella and S. aureus) indicate that hygiene protocols experience lapses along the supply chain.The observed fungal contamination mostly in Market D indicates that inadequate storage conditions which allow mold development exist due to poor humidity control or packaging defects. Mycotoxins which grow from molds present dangerous health threats to humans thus demonstrating the importance of strictly controlling storage and transportation procedures

Research findings demonstrate that microbial contamination requires immediate attention because such risks demand stricter food safety regulations as well as improved hygiene standards for instant noodle handling and storage methods throughout distribution. Partnership between Foodservices Inc. and government regulatory agencies enables the resolution of these matters to improve consumer safety along with international food quality standards adherence.

The proposed recommendations derive from study findings to minimize microbial contamination risks as well as improve food safety standards by enhanced Hygiene Practices in Handling and Processing the implementation of stringent hygiene procedures by manufacturers and market vendors should include multiple requirements: regular hand washing and protective gloves usage and proper sanitation of their equipment.

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