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Microbial Surveillance of Commercial Egg Mayonnaise in Coimbatore and Pasteurized Alternative

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Abstract: *This study is undertaken to determine the microbial quality of commercially available egg mayonnaise sold in Coimbatore, to assess the antibiotic resistance of the isolated bacteria and preparation of pasteurized egg mayonnaise as an alternative. Egg mayonnaise samples (n=20) collected from the Coimbatore district, Tamil Nadu, India. Out of 20 samples analyzed, 17 showed the presence of more than one kind of bacterium. Total of 53 bacterial colonies were isolated from the analyzed samples. 8 samples (40%) showed the presence of Salmonella sp., E. coli, which commonly causes food poisoning, was isolated from 14 (70%) of the samples. Citrobacter species, which are recognized as opportunistic pathogens that can cause foodborne illnesses, were isolated from 5 samples (25%). Staphylococcus sp., which is commonly found on eggshells and poses a significant food safety concern was found in 15 (75%) samples. Some of the isolates showed resistance towards few antibiotics. Pasteurized egg mayonnaise was prepared as an alternative and analyzed for the presence of bacteria. No suspected bacteria were found in the preparation*

Key Words: *Egg mayonnaise, food borne pathogens, antibiotic resistance, pasteurized egg mayonnaise.*

1. INTRODUCTION:

Food habits of Indians changed over the years due to urbanization, busy lifestyles and global influences in Indian culture. Traditional food items are increasingly being replaced by convenient fast-food options, both Indian and Western. Consumption of Fast food as it is ready and tasty to eat and has become a significant and regular component of life. As a result of globalization, western fast-food chains entered into the Indian Markets and established their presence by adapting their menus to Indian tastes, offering vegetarian options and using local spices. Mayonnaise, one of the most widely consumed condiments in the world, was also introduced into the Indian food habits during this period as a key ingredient in the burgers, sandwiches, and wraps. As these chains gained popularity, Indian consumers became familiar with its creamy texture and mild flavour. Over time, Indians started to prepare producing mayonnaise locally, with Indianized versions such as tandoori mayo, mint mayo, and peri-peri mayo to suit local palates. It gradually made its way into Indian kitchens, street food stalls, and even traditional recipes in fusion forms. Today, mayonnaise is widely used in homemade sandwiches, burgers, rolls, salads, as a dip with Indian snacks.

Mayonnaise is an oil-in-water emulsion in which edible vegetable oil is dispersed as the discontinuous phase within a continuous aqueous phase made of vinegar, stabilized by egg yolk as the emulsifying agent. It comes under the class of foods commonly referred to as salad dressing or salad cream. The emulsion is formed by slowly blending oil with a pre-mix that consists of egg yolk, vinegar and mustard and then slowly feeding the oil, resulting in closed-packed foam in oil droplet or coarse emulsion. Because of its low pH and high fat content, mayonnaise is relatively resistant to microbial spoilage. Mayonnaise, one of the most popular condiments, faces the most significant health risk of bacterial contamination. Improper production, storage and handling makes Mayonnaise a good medium for the growth of the microorganisms. One of the raw materials used for the preparation is egg, which may act as a source of contamination for the bacteria *Salmonella* sp., *Listeria* sp. and *E. coli.* Other ingredients used in making mayonnaise *i*.e., oils, vinegars, lemon juice, spices *etc*. can also act as a source of contamination unless it is not handled, stored, or sourced properly. Most of the Mayonnaise based products are kept in the refrigerator to increase their shelf life. The pH and addition of the preservatives and inhibitory acids to the salads can increase the shelf life of the Mayonnaise based products. It has been shown that some pathogens can survive in Mayonnaise based products for several weeks at 5^0C.

In late October 2024, Telangana faced a series of alarming food poisoning incidents linked to the consumption of mayonnaise made from raw eggs culminated with one fatal case and twenty hospitalizations. The Commissioner of Food Safety imposed a ban on preparation of mayonnaise using raw eggs for a period of one year in Telangana with effect from October 30th 2024. Tamil Nadu has imposed a one-year ban on the production, storage, distribution, and sale of mayonnaise made from raw eggs, effective from April 8, 2025. This decision was made due to public health concerns, particularly the risk of foodborne illnesses associated with improper preparation and storage of raw egg-based mayonnaise. In 2018, the Kerala government took steps to regulate the use of certain processed foods like mayonnaise, particularly in light of food safety concerns. Under this background of food poisoning associated with Mayonnaise, the present study tries to evaluate the bacteriological quality of the mayonnaise sample sold in and around Coimbatore and the antibiotic resistance of the bacterial isolates to check the efficacy of commonly used drugs against the bacteria present in the analyzed mayonnaise samples. Presence of bacteria in the suggested alternative, Pasteurized Egg Mayonnaise was also analyzed.

2. MATERIALS AND METHODS:

Sample Collection and Preparation

A total of 20 mayonnaise samples were collected from different restaurants in and around Coimbatore, Tamil Nadu, India, during the period January to March 2023. All the samples collected were immediately transported to the laboratory directly for the microbiological analysis. The samples were kept in sterile containers under aseptic conditions. Information regarding recipes were collected along with each sample. Portions of mayonnaise were collected by sterile spatula. 10g of mayonnaise samples were taken and mixed with 45 ml of buffered peptone water and homogenized with a homogenizer.

Isolation and identification of microorganisms

Homogenized mayonnaise samples were streaked on MacConkey agar, Eosin Methylene Blue agar, Mannitol Salt agar and Salmonella Shigella agar and incubated at 37^0C for 24 hours. Based on the Colony morphology and biochemical test the organisms were identified by the standard microbiological techniques [1].

Antibiotic susceptibility test:

Isolated organisms were subjected to antibiotic susceptibility tests on Mueller Hinton agar plates by disc diffusion method. Twenty-two antibiotics discs including Ampicillin, Ciprofloxacin, Meropenem, Cefotaxime, Piperacillin, Ofloxacin, *etc*. were used against Gram Negative organisms and sixteen antibiotics discs were used against Gram Positive organisms. The test organisms were swabbed on the sterile Muller Hinton Agar plates and antibiotic discs were aseptically placed and the plates were incubated at 37^0C at 24 hours. Diameter of zone of inhibition was measured after the incubation period [2].

Preparation of Pasteurized egg mayonnaise:

Eggs used for the preparation of mayonnaise were purchased from the local supermarket at K G Chavadi, Coimbatore. Eggs were boiled at 60^0C for 3.5minutes for Pasteurization [3]. Pasteurized eggs were wiped with the sterilized cotton towel and used for Mayonnaise preparation. The other ingredients used for the preparation are salt, sugar, oil, vinegar, mustard and garlic and all the ingredients mixed it well using a mixer. Prepared Mayonnaise was used for further analysis.

Microbiological Analysis of Pasteurized Egg mayonnaise

10g of pasteurized mayonnaise was collected by sterile spatula, and homogenized in a homogenizer with 45 buffered peptone water. Pasteurized egg mayonnaise samples were streaked on MacConkey agar, Eosin Methylene Blue agar, Mannitol Salt agar and Salmonella Shigella agar and incubated at 37^0C for 24 hours.

3. RESULT:

Isolation and identification of microorganisms:

Twenty Mayonnaise samples were collected from different restaurants in and around Coimbatore. All the samples were analyzed and found contaminated with different types of microorganisms. A total of 52 bacteria were isolated from the collected mayonnaise samples. More than one type of bacteria was isolated from 17 samples. (Table 1)

Table 1: Microorganisms isolated from the egg mayonnaise sample.

Sl No.	Isolated Bacterial strains	Media used	Number of samples shown growth /20
1	*E. coli*	EMB Agar	14
2	*Staphylococcus sp.*	MSA Agar	15
3	*Klebsiella sp.*	MacConkey Agar	11
4	*Salmonella sp.*	SS Agar	8
5	*Citrobacter sp.*	SS Agar	4

Out of 20 samples analysed, 14 (70%) samples showed the growth of *E. coli*. 11 (55%) samples showed the growth of *Staphylococcus sp. and Klebsiella sp*. *Salmonella sp. and Citrobacter sp.* were isolated from 8 (40%) and 4 (20%) of the samples analyzed respectively. Enteric pathogen *Shigella* species were not detected in the sample screened. The isolated organisms (fig.1) were identified by morphological and biochemical characterization. The results are tabulated in table 2.

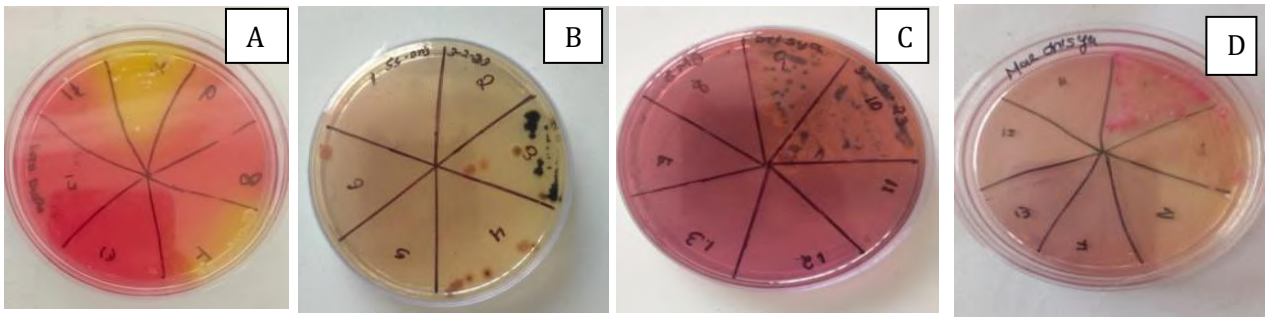

Figure 1 (A-D): Representation of the microorganism streaked on the selective media A: Mannitol salt agar; B: Salmonella shigella agar; C: Eosin methylene blue agar; D: MacConkey agar.

Table 2: Morphological and Biochemical characterization of the isolated microorganisms from Mayonnaise

S.No.	Test	*E. coli*	*Klebsiella sp.*	*Salmonella sp.*	*Citrobacter sp.*	*Staphylococcus Sp.*
1	Gram Staining	G-ve	G-ve	G-ve	G-ve	G+ve
2	Catalase	+	+	+	+	+
3	Oxidase	-	-	-	-	-
4	MR	+	-	+	+	+
5	VP	-	+	-	-	+
6	Indole	+	-	-	-	-
7	Citrate	-	+	+	+	+
8	Urease	-	+	-	-	+
9	Nitrate Reduction	+	+	+	+	+
10	H2S	-	-	+	+	-
11	Spore staining	-	-	-	-	-
12	Motility test	+	-	+	+	-

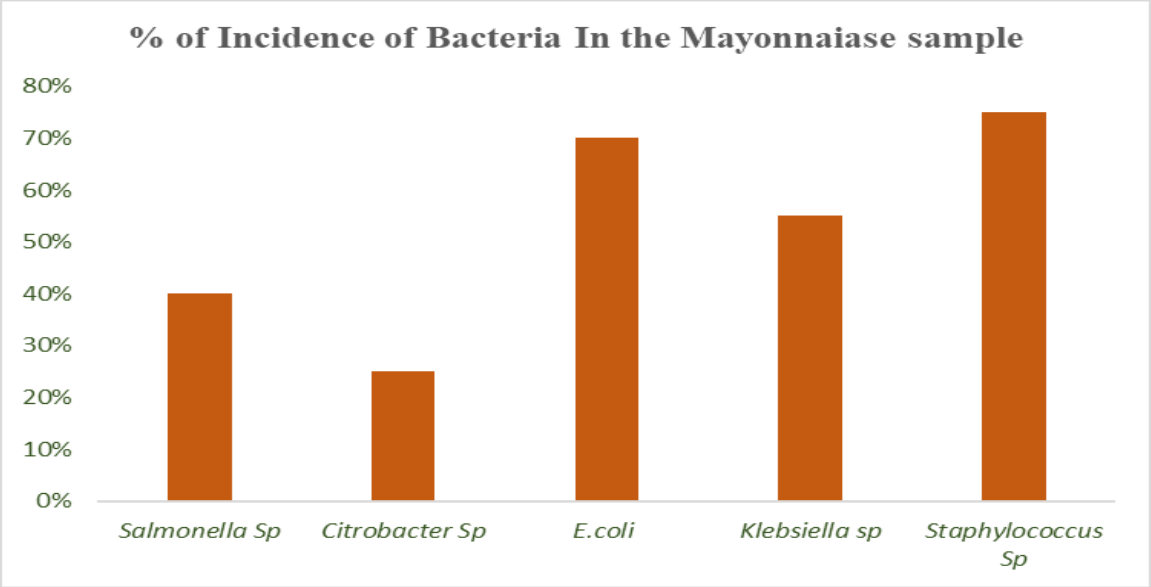

Fig.2. Percentage of Incidence of bacteria in the Mayonnaise sample

Antibiotic susceptibility test of the Bacteria isolated from the Mayonnaise samples:

The widespread use of antibiotics in animals which are used as human food, has resulted in the emergence of novel antibiotic resistant microorganisms that can be transmitted to humans through the food chain and involve human health threat. In this study *Salmonella* sp., *Klebsiella* sp. *and Citrobacter* sp. showed resistance against Ampicillin, *Staphylococcus* sp. showed resistance against Benzylpenicillin and showed resistance against Ampicillin. In this study the antibiotic susceptibility pattern of the isolated microorganisms was analyzed by the Kirby Bauer disk diffusion method. The results were interpreted as either sensitive, intermediate or resistant as per CLSI guidelines 2017.

Table 3: Antibiotic susceptibility test of Gram-negative bacteria isolated from Mayonnaise sample

S. No	Antibiotic disc used	Concentration (µg)	(Zone of Inhibition diameter in mm) and R/S							
			klebsiella Sp.	R/S	*Citrobacter* Sp.	R/S	*E. coli*	R/S	*Salmonella* sp.	R/S
1	ampicillin	10	10	R	6	R	12	R	13	R
2	Piperacillin	100	25	S	25	S	28	S	25	S
3	Cefepime	30	28	S	30	S	26	S	26	S
4	Ertapenem	10	24	S	25	S	22	S	24	S
5	Imipenem	10	23	S	23	S	25	S	24	S
6	Meropenem	10	25	S	25	S	25	S	25	S
7	amikacin	30	20	S	20	S	20	S	22	S
8	Gentamicin	10	20	S	20	S	22	S	20	S

9	Ciprofloxacin	5	26	S	28	S	25	S	24	S
10	Trimethoprim	5	22	S	24	S	22	S	24	S
11	Cefuroxime	30	23	S	23	S	23	S	23	S
12	Amoxicillin	10	18	S	10	S	19	S	19	S
13	Ceflixime	5	25	S	25	S	25	S	25	S
14	Ceftazidime	30	26	S	22	S	28	S	24	S
15	Ofloxacin	5	22	S	20	S	24	S	22	S
16	Cefotaxime	30	30	S	26	S	13	R	30	S
17	Tobramycin	10	20	S	18	S	22	S	22	S
18	Levofloxacin	5	25	S	24	S	26	S	24	S
19	Cefazolin	30	25	S	10	S	28	S	24	S
20	Tetracycin	30	18	S	10	S	18	S	16	S
21	Cephalothin	30	20	S	10	S	22	S	18	S
22	Doripenem	10	25	S	26	S	24	S	20	S

Table 4. Antibiotic susceptibility test of Gram-Positive bacteria isolated from Mayonnaise sample

S. No	Antibiotic Discs used	Concentration (µg)	Zone of Inhibition diameter (mm)	Interpretation
1	Benzylpencillin	1 IU	19	Resistant
2	Cefoxitin screen	10	25	Sensitive
3	Ciprofloxacin	2.5	26	Sensitive
4	Clindamycin	2	25	Sensitive
5	Erythromycin	5	25	Sensitive
6	Gentamicin	10	25	Sensitive
7	Levofloxacin	5	25	Sensitive
8	Linezolid	30	28	Sensitive
9	Rifampicin	1	24	Sensitive
10	Tetracycline	10	25	Sensitive
11	Trimethoprim	5	25	Sensitive
12	Ofloxacin	5	20	Sensitive

13	Tobramycin	10	25	Sensitive
14	Doxycycline	30	26	Sensitive
15	Amikacin	30	25	Sensitive
16	Minocycline	10	25	Sensitive

Microbiological Analysis of Pasteurized Egg mayonnaise:

The pasteurized egg mayonnaise was streaked on the MacConkey agar, Salmonella Shigella agar, Mannitol Salt agar, Eosin Methylene Blue agar and kept it for the incubation at 37^0C for 24 hours to detect the presence of microorganisms in the pasteurized mayonnaise. There was no characteristic growth of microorganisms that could be detected in the pasteurized mayonnaise.

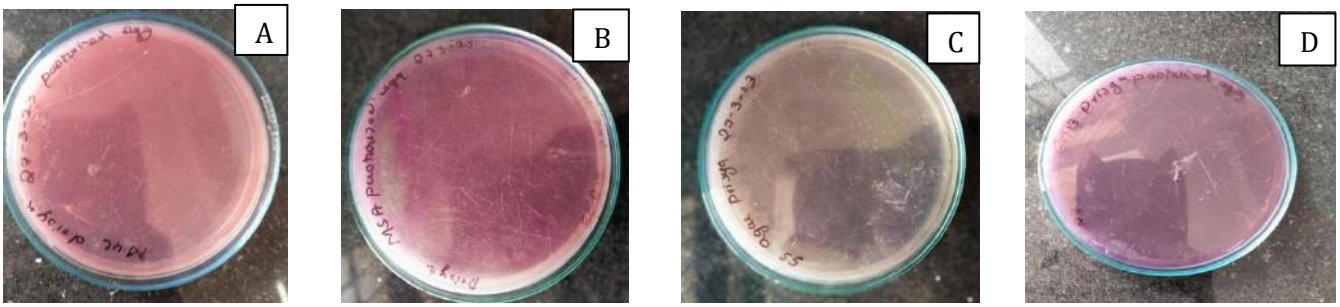

Figure 3 (A-D): Pasturised mayonnaise-streaked A: MacConkey agar; B: Mannitol salt agar; C: Salmonella shigella agar; D: Eosin methylene blue agar.

4. DISCUSSION :

Food quality testing is an essential component of modern food safety management due to the rising concerns over contamination, the expansion of global food supply chains, and increasing consumer expectations regarding product integrity. With the growing reliance on processed and ready-to-eat (RTE) foods, there is an elevated risk of microbial contamination, adulteration, and spoilage. Effective quality testing not only ensures that food products meet established safety and nutritional standards but also plays a pivotal role in regulatory compliance, consumer confidence, and the prevention of foodborne diseases. In the present study, the microbiological quality of commercially available egg mayonnaise sold in restaurants around Coimbatore, Tamil Nadu, was assessed. Given that RTE foods are typically consumed without additional heat treatment, maintaining strict microbial safety standards is critical. Similar microbiological concerns were reported by Gurler (2015), who detected *Listeria monocytogenes* and *Salmonella* spp. in 6% and 8% of 261 RTE food samples in Turkey, respectively, while *Escherichia coli* was found in 4% of the tested products. In comparison, the current study revealed a significantly higher contamination rate, with *Salmonella* spp. present in 40% and *E. coli* in 70% of the analyzed samples.

Our findings align with those of Zhu et al. (2012), who reported *Salmonella enteritidis* in 22 out of 30 mayonnaise-based food samples from Dhaka. Similarly, Eromo et al. (2016) documented the prevalence of *E. coli* (29.6%), followed by *Salmonella* spp. (12.7%) and *Staphylococcus aureus* (9.9%) in Ethiopian street foods. The present study also identified *Citrobacter* spp., found in 20% of the samples, which is consistent with results by Afroz et al. (2023), who found similar contamination rates among Gram-negative Enterobacteriaceae in mayonnaise samples. These pathogens are commonly introduced due to substandard hygiene during food preparation and handling. Augustin et al. (2020) highlighted the role of inadequate food-handling practices in contributing to the burden of foodborne illnesses in France. Weistein (1991) reported that over 90% of sanitation issues in food services were related to poor personal hygiene, with insufficient handwashing practices alone responsible for more than 25% of foodborne disease outbreaks. Contamination may occur through various means such as cross-contamination, improper storage temperatures, undercooked ingredients, or exposure to infected food handlers (Effimia, 2015).

The microbial isolates identified in this study included *Staphylococcus* spp. (75%), *E. coli* (70%), *Klebsiella* spp. (55%), *Salmonella* spp. (40%), and *Citrobacter* spp. (20%). These results mirror earlier studies that have reported microbial contamination in mayonnaise, particularly when hygiene protocols are not strictly followed. For example, studies in Brazil showed that homemade mayonnaise samples exceeded microbial limits for molds and yeasts, further illustrating the consequences of improper food handling. Antimicrobial resistance testing revealed that all isolates were resistant to Ampicillin. Additionally, *E. coli* demonstrated resistance to Cefotaxime, while *Staphylococcus* spp. exhibited resistance to Benzylpenicillin. These findings reflect broader concerns regarding antibiotic resistance, as noted by Gosling et al. (2012), who observed elevated levels of ciprofloxacin resistance in *E. coli* isolates from turkeys in the United Kingdom. Subratty et al. (2004) also reported that although food vendors in rural Mauritius were knowledgeable about hygiene practices, many failed to implement them, often underestimating the potential risks to public health. This preliminary investigation highlights the widespread microbial contamination in egg mayonnaise sold in Coimbatore. The presence of enteric pathogens such as *Salmonella* and *E. coli* suggests deficiencies in sanitary practices, particularly in the handling, transport, and storage of raw ingredients under non-sterile conditions. While commercial mayonnaise typically contains acidic ingredients like vinegar or lemon juice that suppress microbial growth, homemade products using raw eggs and lacking preservatives pose a much higher risk. Smittle (2000) emphasized that the acidic environment in commercial mayonnaise is generally sufficient to inhibit pathogens like *Salmonella* and *E. coli O157:H7*, whereas improperly prepared homemade mayonnaise remains a significant source of contamination.

5. CONCLUSION:

This study highlights the most relevant topic of food poisoning by mayonnaise. From twenty Mayonnaise sample a total of 52 bacteria were isolated. Food borne illness causing organisms, *Salmonella* sp, *E. coli*, *Staphylococcus* sp and opportunistic pathogen *Citrobacter* sp was there in the isolated bacteria. However, the presence of organisms could be attributed by the unhygienic conditions during preparation, handling and serving of the mayonnaise in restaurants. These foods may also get contaminated if the food preparation machines are exposed to dust and flies. Mixing the food with mayonnaise can increase the incidence of mayonnaise being linked to food borne illness, so freshly prepared pasteurized mayonnaise can be used as an alternative to prevent food poisoning. Strict implementation of the hygienic standards may help to reduce the contamination rates.

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