

# Bacillus cereus and Biryani: An Analysis of the Microbiological Quality and Food Premises Trends in the City of Toronto

Scott Szyiko, Advisors: Dr. Richard Meldrum & Dr. Melissa Moos, with Toronto Public Health Quality Assurance

RYERSON UNIVERSITY

## Introduction

Biryani is a mixed rice dish that has its roots in South Asian cuisine. As a rice-based dish, it can be difficult for food handlers to prepare Biryani quickly. As a result, Biryani is often prepared in large batches well before service time and maintained as a ready-to-serve food for customers.

*Bacillus cereus* is a spore-forming, potentially pathogenic species of bacteria that is ubiquitous in the environment, and has been isolated in soil, vegetation and dust (Berthold-Pluta, Pluta & Garbowska, 2015). As these bacteria grow in a wide temperature range and have the ability to produce heat-stable toxins that may not be destroyed by conventional re-heating methods, control of spore germination, bacterial growth, and toxin production through proper time and temperature control is essential to prevent foodborne illness.

The nature of Biryani as a large batch food item that is prepared well in advance of service and is comprised of ingredients in which *B. cereus* has frequently been isolated including rice, meat, vegetables, and spices, renders it hazardous for contamination and growth of this organism.

As such, this study aims to determine the factors that contribute to potential *B. cereus* contamination and growth in Biryani with respect to ingredient use/storage, food handling, and food premises management.

## Methods

1. Upon entering each food premises, a questionnaire was completed with the operator
2. Biryani sample temperatures were recorded using a thermocouple thermometer that was cleaned and disinfected before each use
3. A total of 21 samples from 11 premises were collected with the use of aseptic techniques and Whirl-pak sample bags
4. Biryani samples were submitted to the University of Guelph Laboratory for identification and enumeration of *B. cereus* species
5. The laboratory results were analyzed and cross-referenced, where possible, with relevant questionnaire data
6. The questionnaire data was considered across all food premises, and recommendations were made based on the results

## Results & Discussion

### Laboratory Results:

- Only 1 of 21 samples was found to be positive for *B. cereus*, but at a level that is considered acceptable in terms of food safety (2.50E+01 cfu/g) (Public Health Agency of Canada, 2012).
- Although these levels are considered acceptable, the fact that *B. cereus* was isolated in Biryani reinforces the need for proper time and temperature practices to control for potential growth and toxin production.

### Questionnaire Results:

Table 6  
Method of Storage and Serving When the Biryani is Prepared as a Complete Dish

(A) Storage of Biryani Before Service Time (i.e. Directly After Cooking)	
Method of Storage	Number of Restaurants (n = 6)
Stored on the Counter Top to Cool	1
Stored in Refrigerator to Cool	0
Stored Hot on Stove Top/in Steam Table	4
Stored Hot in Hot-Box Container	1
(B) Storage of Biryani During Service Time	
Method of Storage	Number of Restaurants (n = 6)
Stored on the Counter Top	0
Stored in the Refrigerator	1
Stored Hot on Stove Top/in Steam Table	4
Stored in Hot-Box Storage	1
(C) Method of Serving Biryani	
Method of Serving	Number of Restaurants (n = 6)
Re-heated from Counter Top Storage	0
Re-Heated from Refrigerator	1
Served Hot from Stove Top/Steam Table	4
Served Hot from Hotbox Storage	1
Re-heated from Counter Top Storage	0

Table 7  
Method of Storage and Serving When Biryani Ingredients are Prepared Separately

(A) Storage of Biryani Ingredients Before Service Time (i.e. Directly After Cooking)	
Method of Storage	Number of Restaurants (n = 5)
Stored on the Counter Top to Cool	4
Stored in Refrigerator to Cool	1
Stored Hot on Stove Top/in Steam Table	0
Stored Hot in Hot-Box Container	0
(B) Storage of Biryani Ingredients During Service Time	
Method of Storage	Number of Restaurants (n = 5)
Stored on the Counter Top	1
Stored in Refrigerator to Cool	3
Stored Hot on Stove Top/in Steam Table	1
Stored Hot in Hot-Box Container	0
(C) Method of Serving Biryani	
Method of Serving	Number of Restaurants (n = 5)
Pre cooked, cooled ingredients are assembled and re-heated to order	4
Pre cooked, hot ingredients are assembled to order	1

*Escherichia coli* Testing

- Results show that there are two main ways that Biryani is prepared. The method of storage and service of Biryani differ depending on which method of preparation is used, as shown in tables 6 & 7.
- When Biryani is cooked as a complete dish, it is more likely to be kept hot between initial cooking and service in the restaurant. In contrast, when the Biryani ingredients are cooked separately, they are more likely to be cooled down after the initial cooking process (often at ambient temperature), increasing the potential for *B. cereus* toxin production as well as germination of heat-resistant spores that may have survived the initial cooking process.

- The hazard of foodborne illness may also be increased when Biryani ingredients are left to cool down because, although the eventual re-heating may kill *B. cereus* bacteria, it is unlikely that the heat-stable toxin that may have developed in the food during the cooling process will be destroyed (Food and Drug Administration, 2012).

### Other Notable Results:

- The positive sample was provided by the only food premises operator that indicated on the questionnaire that they: (a) store their raw rice uncovered and therefore open to the kitchen environment, and (b) do not normally wash/rinse their raw rice before it is cooked
- All 11 food premises operators (100%) indicated that they do not provide any form of food-safety training for new staff. Further, there is a significant gap between the number of food handlers employed at each premises compared to the number that have obtained any form of food safety certification.

## Conclusion & Recommendations

Overall, the microbiological quality of Biryani with respect to levels of *B. cereus* was found to be quite good.

It is recommended that food handlers prepare and cook Biryani as a complete dish, as the results show that when this method is used, it is more likely to be kept at temperatures that will control for *B. cereus* growth.

Because of the relationship between the questionnaire data and the positive sample of Biryani, future research could focus on the impact of washing/rinsing raw rice on levels of *B. cereus* contamination both pre and post-cooking. In addition, as *B. cereus* is ubiquitous in the environment, future research could also consider the microbiological quality of rice with regards to storage, in order to determine whether there is a connection between different methods of storage and environmental contamination of raw rice.

## References

- Berthold-Pluta, A., Pluta, A., & Garbowska, M. (2015). The effect of selected factors on the survival of *Bacillus cereus* in the human gastrointestinal tract. *Microbial Pathogenesis*, 82, 7-14.
- Food and Drug Administration. (2012). Bad bug book: Foodborne pathogenic microorganisms and natural toxins. Second Edition. [*Bacillus cereus* and other *Bacillus* species, pp. 92-95].
- Public Health Agency of Canada. (2012). *Bacillus Cereus* - Pathogen Safety Data Sheet. Retrieved February 21, 2017, from <http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/bacillus-cereus-eng.php>