Chapter 6
Print ISBN: 978-93-5547-729-3, eBook ISBN: 978-93-5547-730-9

A Study on pH Metric Method for Detection of Cooked Rice Adulteration

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DOI: 10.9734/bpi/pcsr/v2/2549A

ABSTRACT

In proposed research work, the pH of cooked rice is measured for different interval of storage time. % adulterated cooked rice samples are prepared by partial admixture of spoiled rice in fresh rice and subjected for pH analysis. pH of fresh cooked rice is slightly acidic. Under storage condition, evaporation of moisture at room temperature accumulates salt in rice. Due to salt accumulation pH of cooked rice is inclined towards alkaline side. For detection of spoilage of cooked rice with different interval of storage and adulteration, pH of Kolam variety of rice is detected from 0 hours to 36 hrs. Further, rice is adulterated by partial admixture of spoiled rice of 12 hours' duration with fresh rice. pH of each adulterated mixture is determined. 50 domestic and commercial are collected from Otur area and analysed for pH measurement. Results shows proportionate linear increase of pH with time. Further four varieties of rice viz. Indrayani, Kolam, Basmati and Ambemohor was % adulterated with partial admixture of corresponding variety of spoiled rice. pH of each mixture determined. same trends of results are obtained. The study also indicates the pH metric method for detection for spoiled or adulterated rice. This has significance for reducing the health hazards caused by B. Cereus bacteria by spoilage of rice during stored period. The accumulation of salt caused by moisture evaporation raises the pH of cooked rice. This technology can be successfully expanded to detect rice adulteration. A cheap, rapid, and easy pH metric method can successfully identify the extent of adulteration and thereby rice rotting.

Keywords: pH metry; cooked rice; adulteration.

1. INTRODUCTION

The main goals of food adulteration are monetary gain and the elimination of scarcity. Rice is a common food item found all over the world. For this objective,

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various physical, chemical, and biochemical methods for detecting fresh uncooked rice and other food items have been developed. [1-2], but there is no method yet developed for detection of cooked rice adulteration. In India, it is usual practice for consuming cooked rice by poor families, even after 24 hours to avoid wastage of food. After long storage period, cooked rice is spoiled due to growth of bacteria *Bacillus Cereus* [3]. Goals of predictive mathematical modeling include quantitative estimation of microbial growth in foods, prediction of microbial safety, and determination of the shelf life of food products. During the last several years, few studies have been performed to model the growth of *B. cereus* in foods [4,5].

30 different types of food poisoning incidents are observed with cooked rice are attributed to growth of *Bacillus Cereus* [6]. This bacterium grows well between temperatures 7 to 48°C. Its growth takes place after cooking and cooling [7]. Food poisoning by this bacterium are associated with emetic toxin and three different types of enterotoxins. Food-borne bacteria have to date been the most well investigated and monitored causes of GI infectious disease, our understanding of the microbial agents of GI illness remains limited. Comprehensive diagnostic studies of intestinal infections indicate that between 50 and 60 % of all causative agents are unidentified. In addition, GI illnesses caused by toxin producing bacteria, such as B. cereus, are almost certainly underestimated due to lack of diagnostic tools [8]. With recent advances in biotechnology, DNA based techniques evolved rapidly and proved successful over conventional non-DNA based methods to purge the problem of adulteration at commercial level [9,10]. These toxins mainly cause food poisoning in the form of diarrhea and vomiting [11]. Such information led us to avoid the consumption of cooked spoiled rice after long period of storage. Commercially, rice is cooked in hotels, chinesese restaurant's and take away shops. To avoid delay for cooking and quick service to customers, it is already kept in cooked condition to make different rice menu. Such long storage results in spoiling of rice. Remaining rice after one day of cooking may serve to customer directly or it may have adulterated by partial admixture of spoiled rice in fresh rice to avoid wastage. So across the road during journey, food poisoning cases are very frequent. Physically it is very difficult to identify the long storage spoiled rice or adulterated rice. There are small observations like spoiled rice hardens after long storage period, yet even after 24 hours' storage, there is no offensive smell detected, showing inappropriateness of physical methods [2].

Rice when cooked in hard water, accumulates salts due to evaporation of moisture shows inclination towards alkaline pH after some time. The strains of *Bacillus Cereus* grow between pH between 4.9 to 9.3 [5]. Fresh cooked rice shows slightly acidic pH from 6.2 to 6.8 but as time passes during storage period at room temperature, its pH increases from acidic to alkaline side. Spoiled rice after 24 hours' storage shows alkaline pH. Based on such observation spoiled rice and adulterated rice can be detected. pH metric method is very simple, quick and easy method for detection of spoilage and adulteration of cooked rice.

In proposed research work, the pH of cooked rice is measured for different interval of storage time. % adulterated cooked rice samples are prepared by partial admixture of spoiled rice in fresh rice and subjected for pH analysis. Such method is extended for 50 domestic and commercial samples to assess quality of rice for common man consumption.

Fig. 1. White cooked rice collected for pH measurement

1.1 Experimental Work

For detection of spoilage of cooked rice with different interval of storage and adulteration, pH of Kolam variety of rice is detected from 0 hours to 36 hrs. Further, rice is adulterated by partial admixture of spoiled rice of 12 hours' duration with fresh rice. pH of each adulterated mixture is determined. 50 domestic and commercial are collected from Otur area and analysed for pH measurement.

2. MATERIALS AND METHODS

Four varieties of rice viz. *Indrayani, Kolam, Basmati and Ambemohor* are purchased from Otur market. pH of such cooked fresh, spoiled and adulterated samples are determined after simple treatment. pH is determined on Elico pH meter model no.

2.1 Preparation of Cooked Rice

Each variety of 100 gm rice is washed with 500 ml distilled water and cooked in 100 ml simple water.

2.2 Storage of Rice for Different Interval of Time

The Kolam variety of rice after cooking is stored up to 36 hours at room temperature. During storage condition, it is mixed thoroughly after 6 hrs.

2.3 Adulteration of Rice of Each Variety

Cooked rice of each variety is % adulterated by partial admixture of 12 hours spoiled rice in fresh cooked rice with same varieties. For % adulteration, 0, 10,

30, 30, 40 and 50 gm of 12 hours spoiled rice is admixed with 100 gm fresh rice to form 0, 10, 20, 30, 40 and 50 % adulrated rice respectively.

2.4 Collection of Rice Sample from Our Area

100 cooked rice samples are collected from Otur area, irrespective of varieties. 50 rice samples are collected from houses and restaurant's.

2.5 Determination of pH of Fresh, Stored, Adulterated and Collected Rice Samples

pH of each variety and cooked rice samples are determined by pH meter on Elico model. First pH meter is standardized by using pH 4 and pH 7 solution.

For determination of pH of cooked *Kolam* rice for different interval of storage, 10 gm of each time sample from 0 to 36 hours are weighed on chemical balance transferred to 100 ml distilled water. It is stirred for 10 min. pH of resulting stirred solution is determined. For determination of pH of adulterated rice. Each % adulterated 10 gm sample are subjected to same procedure after 6 hours of adulteration. Finally, for pH determination of collected cooked rice sample, are determined using same procedure as soon as received within 30 min. of collection.

3. RESULTS AND DISCUSSION

3.1 pH of FRESH cooked Rice of Different Varieties

The 100 g rice was cooked in simple domestic water and stored at room temperature and pH of each variety of fresh cooked rice was determined. It is observed that white cooked rice when fresh shows the slightly acidic pH. Table shows the initial pH of four varieties of cooked rice after 0 hours of cooking.

Table 1. pH of fresh cooked rice after 0 hours of cooking

No	Rice variety	pH	Color
1	Kolam	6.3	White
2	Indrayani	6.5	White
3	Basmati	6.6	White
4	Ambemohor	6.8	White

From this observation shows that, cooked rice when fresh shows slightly acidic pH. Carbohydrate food items shows acidic pH due to carbohydrate content [7].

3.2 pH of Kolam Variety Cooked Rice of Different Interval of Time in Under Storage

After determination of initial pH of fresh cooked rice samples, further effect of storage time on pH of cooked rice samples are determined for *Kolam* variety of

cooked rice at room temperature. Graph in Fig. 2 shows pH of Kolam variety for different interval of storage from 0 to 36 hours while table 2 Color of rice after different interval of time.

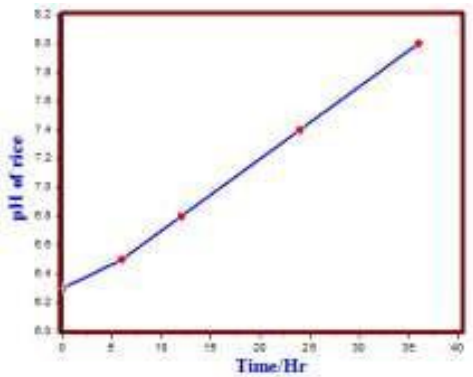

Fig. 2. Effect of storage time on pH of Kolam variety of cooked rice

Table 2. Color of Kolam cooked rice sample during storage

No	Time/Hrs.	Color
1	0	White
2	6	White
3	12	Light yellow
4	24	Yellow
5	36	Brown

pH of cooked rice increases during storage condition. Increase in pH also reflected from color of cooked rice samples. During the storage condition room temperature, salt accumulates in rice. After 24 hrs, rice hardens. In Indian villages, cooked rice after warming regularly consumed by peoples. After 24 hours' rice hardens due to heating, this also accumulates salt. Heat treatment after 12 to 24 hours, kills all B. Cereus bacteria. But it has temporary effect. The spore of bacteria germinates again and grows in cooking rice. Due to evaporation of moisture either storage or by heating accumulates salt, reflected from color of cooked rice samples. From 6 hours to further, color changes from white to brown due to accumulation of iron in cooked rice samples [12]. Rice for domestic purposes cooked in hard water and after some hours' salts starts accumulating in rice so pH increases and color changes. But this pH range from 6. 0 to 9.0 is very favorable for growth of *B. cerus* bacteria so health hazards increases. pH metric method is an important tool to determine rice quality.

pH of % adulrated cooked rice by admixture with 12 hours stored rice indicates pH increases from 1 to 36 hours. The pH of each variety is determined after 6 hours of adulteration. Just after 20 % adulteration it achieves alkaline pH. The increase in pH attributed to accumulation of salt.

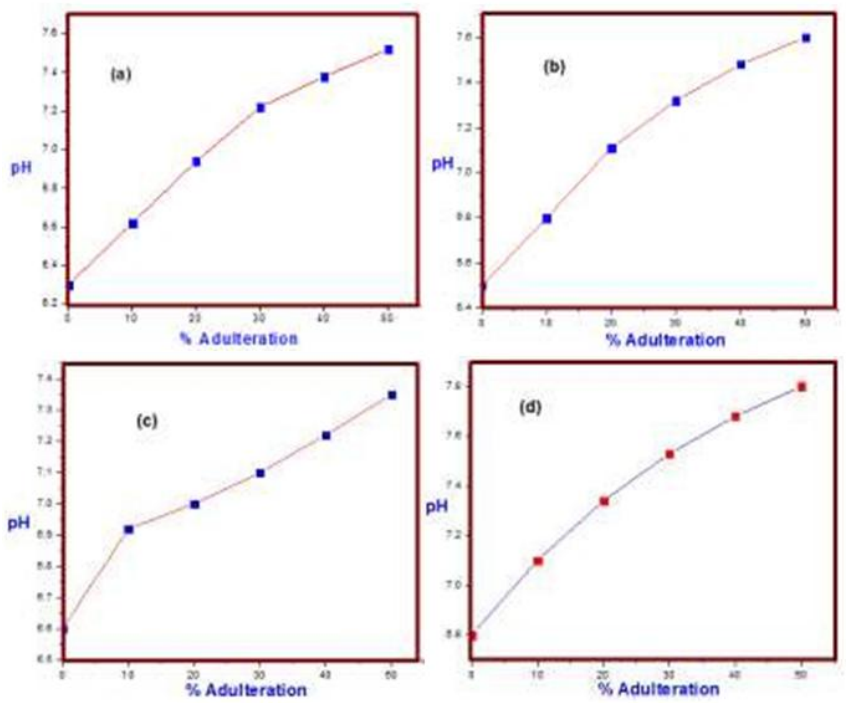

Fig. 3. Effect of % adulteration of pH of cooked rice varieties
(a)Kolam, (b)Indrayani. (c)Basmati, (d)Ambemohor

3.3 Collection and Determination of pH of Cooked rice Samples from Houses and Restaurants

50 cooked rice samples from different houses and hotels are collected and subjected for pH determination to monitor quality for consumption of house members and customers. Table 3 represents the pH of cooked rice collected samples. Quality of cooked rice for consumption is mainly depend on pH. Lower the pH, safer is rice for consumption, while higher the pH of cooked rice, chances of health hazards increases. During the collection of rice sample from houses, house members are advised for avoiding consumption of cooked rice after longer time and health risk imposed by consumption of spoiled rice.

The 50 cooked rice samples are collected from houses and restaurants. Out of 50 cooked rice samples, 7 samples are household while remaining are collected from restaurant's. In these samples, 43 samples are acidic while 7 samples are slightly alkaline. This alkaline cooked rice samples may be served to consumer for longer period of time responsible for health hazards.

The proposed research work indicates the pH metric method for detection for spoiled or adulterated rice. This has significance for reducing the health hazards caused by *B. Cereus* bacteria by spoilage of rice during stored period. From this pH metric study, it is advised that avoid the consumption of cooked rice after long period of storage or store cooked rice under 5 OC to avoid the growth of bacteria. It is suitable that cooked rice can be cooked in smaller quantities as per requirement to get health benefit.

4. CONCLUSION

Storage of cooked rice at room temperature is accompanied with growth of *B. Cereus* bacteria responsible for potential health hazards, such spoilage of rice can be detected by pH metric determination of cooked rice after different interval of time. Increase in pH of cooked rice caused due to accumulation of salt by evaporation of moisture. Such method can be successfully extended to find adulteration of rice. The extend of adulteration and hence spoilage of rice can be successfully determined by simple, quick and easy pH metric method.

ACKNOWLEDGMENT

Authors are very thankful for coordination of Head of chemistry department, Principal of A. W. College, Otur for motivation of research and Chemistry Department Lab Attendants and Lab Assistant for lab management and coordination to research students.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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This chapter is an extended version of the article published by the same author(s) in the following journal.
International Journal of Chemical and Physical Sciences, 7(RTCS): 2018.