

Project Title:

To test the hypothesis regarding suitable cooking temperature and duration of the popular Indian flat bread, most commonly known as 'Chapati' or 'roti' and whether overcooking them will lead to degradation in the nutritional quotient. [MA108]

Category:

Biochemistry (BI)

Synopsis:

The aim is to conduct experiments in pursuit of determining the delta values of nutrition in one of the most commonly used Indian staple food, Wheat Chapati. For this we first obtain a standardized sample which can be procured multiple times and have a homogenous spread of constituents and be isentropic. Preparing homemade samples repeatedly which all have the same initial flour mix is difficult as well as cumbersome, therefore it is more suitable in lieu of the experiment that we take as samples pre-made rotis available in the market, these will have the same properties no matter when and where they are purchased. We now perform laboratory tests on them to determine the nutritional constituents per mass of the roti, then we cook these pre-made rotis exactly to the specification mentioned by the market producer and then perform the same tests. After having determined the properties of the rotis in their uncooked (partially) and cooked to precise values of temperature and time, we then proceed to overcook freshly obtained rotis to the same temperature but increasing and decreasing the duration of cooking by a step interval of two seconds. We then perform the same tests on each iteration and compare and contrast the change in the value of nutritional content by drawing the graph between duration of cooking and nutritional content value thereby determining the rate of nutritional degradation.

Project Information:**Objectives and introduction:**

Even in the fast-paced world that we live in at current times, it is seen that more and more people take notice and make themselves aware of what they eat now. The health conscious, look more and more closely at the 'ingredient list' plastered on their purchase from the neighborhood grocery store or the supermarket. We have witnessed, companies coming out with low calorie and/or low sugar version of their products both selling side by side with their 'standard' versions. Since we as a group of people have developed a lens for checking out what constitutes the items which finally end up in our stomachs, why do we restrict this motivation of being nutrition aware towards only the things we get and eat from outside our homes. We realize and come to the understanding that whatever eatables we get packaged and pre-processed must have been made with optimal manufacturing or cooking processes rendering them consumption worthy up to their expiration period, we believe that market obtained eatables are made under ideal conditions cooked to their optimum duration and temperature. What we fail to realize that is that we have not put under the same scrutiny and review the food we prepare at home. Do we know what happens if we put our rotis/chapatis even 30 seconds more on the 'tawa' than usual? What happens if we leave the chapatis and the 'parathas' in the refrigerator for storage at a stretch for a week and then eat them? What about the 'dals' and 'sabjis'?

we cook, store in the refrigerator and then eat two days later, what exactly happens to their nutritional content? Do the macro and micro nutrients change their chemical structure over time and degrade into something else or does nothing major happen?

Innovation:

To find the processes, food items consumed by the majority Indians undergo when they're overcooked or stored for a long time becomes immensely important considering the impact the knowledge would have owing to the immensity of the scale. This serves as a great motivation for me to initiate my own research project starting with studying the characteristics of wheat chapatis or rotis to determine how the nutritional potential of these ubiquitous food item known to every Indian changes with undercooking, overcooking and long storage.

To initiate such a project we start from a small scale, we will assess the properties of market obtained chapatis from Ready Roti Indian Pct. Ltd. Company under the brand name of Harvest Gold, this specific pre-made rotis were chosen for multiple reasons:

1. Easily available throughout India;
2. Manufacture claims the rotis to be made from 100% whole wheat flour without any component such as Rawa Suji, and choker being extracted.
3. Has clear cooking instruction to be followed and also has clear mentioned nutritional information.
4. Each packet has 5 piece of rotis which cost only 30 rupees making the experiment quite cheap

There are several benefits of using market obtained rotis for experimental purposes rather than homemade ones, some of which are described below:

1. Market obtained rotis can be assumed to have almost the same constituent make up and composition no matter which packet and from where it is obtained. This helps to set a standard before beginning the experiment as it allows us to set a baseline to which all other iteration of differently cooked rotis can be compared to.
2. Market obtained rotis already have nutritional information mentioned on the packet to which we can calibrate our laboratory tests to ensure maximum accuracy in all further tests.
3. As the cooking instruction are mentioned on the market obtained rotis, there is no need for us to research into setting a standard to cook to which a baseline can be attributed to.
4. The dough mixture for the homemade rotis is made manually and therefore subsequent dough to make more rotis can be made erroneously of a different composition or mixture thereby destroying the efforts to set a baseline and also making past experimental results a waste.

It has been already established that there is significant nutrition degradation when different types of food are overcooked but it is our main objective in this endeavor to determine the rate at which the degradation occurs in whole wheat chapatti/rotis as this fact is still unknown. For this we will cook the chapatti according to the specification mentioned on the packet, measure the nutritional content and then overcook a fresh chapatti by increasing the duration under which heat is applied to the chapatti each time by 10 seconds followed by measuring the nutritional content of each specimen. Testing of multiple specimens with different cooking times will give us a clear idea of the rate at which

nutritional value of the chapattis decrease.


Algorithm:

1. Conceptualizing the Project
2. Literature Search to understand the work done in the past
3. Preparing a testing protocol for getting the Ready to Eat Chapatis analyzed
4. Procurement of the Ready to Eat Chapatis (Harvest Gold)
5. Finding a suitable and credible lab for conducting the tests on the Chapatis
6. Getting the Chapati samples analyzed at the Testing Lab (M/s Arbro Pharmaceutical Pvt. Ltd.)
7. Discussion with the lab personnel as to what methodology to be adopted for cooking and overcooking of the Ready to Eat Chapatis
8. Analyzing the results obtained and penning down the observations
9. Planning a futuristic way forward to the Project

Method:

1. Initial testing is done on test specimen which is cooked to the exact specification as mentioned on the pack, i.e. the chapati is cooked on one side for 20 seconds and then turned to cook on the other side for 15 seconds. This initial test is done to standardize the results from which all other further results will be compared to.
- 2.

Table 1. Table entry for each specimen.

NUTRITION CONTENT TYPE	MARKET PRODUCERS REFERENCE VALUE - per 100 grams	EXPERIMENTALLY OBTAINED VALUE - per 100 grams
Proteins and Amino Acids	3.16 gram	
Minerals		
i) Calcium	50 mg	
ii) Iron	1 mg	
iii) Sodium	120 mg	

3. Next, to prepare the seconds specimen we repeat the above test with a specimen which is cooked to the exact same specification as the first one but add another 5 seconds of cooking on both the sides of the chapati. Cook on one side for 20 seconds, on the other side for 15 seconds and then flip once to cook for additional 5 seconds and then flip again to cook for additional 5 seconds.
4. To prepare the third and the last specimen we repeat the above test with a specimen which is cooked to the exact same specification as the first one but add another 10

seconds of cooking on both the sides of the chapati. Cook on one side for 20 seconds, on the other side for 15 seconds and then flip once to cook for additional 10 seconds and then flip again to cook for additional 10 seconds.

Conclusions/Results:

I. RESULTS AND CONCLUSION

We started from the hypothesis that over cooking leads to degradation of the nutritional content of some particular foods and to test this hypothesis we prepared one standard and two over cooked specimens of chapatis. The results are tabled below:

Table 2. Result of Specimen 1.

NUTRITION CONTENT TYPE	MARKET PRODUCERS REFERENCE VALUE - per 100 grams	EXPERIMENTALLY OBTAINED VALUE of SPECIMEN 1 - per 100 grams
Proteins and Amino Acids	3.16 gram	8.94 mg
Minerals		
i) Calcium	50 mg	120.82 mg
ii) Iron	1 mg	2.38 mg
iii) Sodium	120 mg	372.19 mg

As we can see from here that the packet marked nutritional information is starkly different to what was obtained after cooking the chapati to exact specification, this result was crucial to obtain so that further tests could be compared to actual values and not values which were approximate or doubtful.

Table 3. Specimen 2 compared to Specimen 1.

NUTRITION CONTENT TYPE	EXPERIMENTALLY OBTAINED VALUE of SPECIMEN 1 - per 100 grams	EXPERIMENTALLY OBTAINED VALUE of SPECIMEN - 2 per 100 grams
Proteins and Amino Acids	8.94 mg	8.90 mg
Minerals		
i) Calcium	120.82 mg	110.98 mg
ii) Iron	2.3 mg	1.93 mg
iii) Sodium	372.19 mg	309.49 mg

Table 4. Specimen 3 compared to Specimen 2.

NUTRITION CONTENT TYPE	EXPERIMENTALLY OBTAINED VALUE of SPECIMEN 2 - per 100 grams	EXPERIMENTALLY OBTAINED VALUE of SPECIMEN - 3 per 100 grams
Proteins and Amino Acids	8.90 mg	8.85 mg
Minerals		

i) Calcium	110.98 mg	108.76 mg
ii) Iron	1.93 mg	1.88 mg
iii) Sodium	309.49 mg	319.82 mg

It is quite evident that our hypothesis has been tested in a limited sense but we as we had three specimens in total and each specimen was tested for a total of four discrete quantities thus we can deduce from these results that the pattern will most likely repeat for further increase in cooking duration of more specimens. The values of all the four quantities, i.e. Total proteins, Calcium, Iron and Sodium decreased as the cooking duration was successively increased by 10 seconds overall each time, the only exception to the pattern is sodium which actually increased from 309.49 mg per 100 grams to 319.82 mg per 100 grams, this can be chalked out to lab testing error as the unexpected increase in the third specimen by 10.33 is insignificant to the decrease of 62.7 which was observed going from the first specimen to the second.

✖ **The market producers reference values of the nutrients may be differing from the experimentally obtained values basis the difference in testing methodology and instrumentation used.**

Acknowledgement and reference links:

I. ACKNOWLEDGEMENT & REFERENCES

1. It was crucial for us to get the tests done only from a certified lab with proper equipment so that the tests are done with proper validated methodology and by expert and experienced personnel and for having credible observations. Hence the tests were done at **M/s Arbro Pharmaceuticals Pvt. Ltd's Analytical Division, Kirti Nagar, Delhi**. The lab is a Govt. approved Test House for conducting Analytical procedures. They have validated processes and methodology. The lab used Atomic Absorption Spectrophotometer for analyzing the samples. I acknowledge the support provided by M/s Arbro Pharmaceutical Pvt. Ltd. The total cost incurred in getting the tests conducted was to the tune of INR 7080/, however, the spend is not an issue and further testing can also be planned for various other parameters as the intent is to expand my research work as the results I have got this time has made me more intrigued about the nature of cooking and has made me more motivated to analyze more food items that are consumed by the population at large viz. rice, noodles etc.

2. I have used the following references for understanding and planning the aforesaid research viz.

<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2621.1981.tb04471.x>

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<https://onlinelibrary.wiley.com/doi/abs/10.1094/CCHEM.2000.77.5.615>

<https://www.cabdirect.org/cabdirect/abstract/19521400601>

https://scholar.google.co.in/scholar?start=10&q=Effect+of+overcooking&hl=en&as_sdt=0,5

<https://en.wikipedia.org/wiki/Wheat>

Have you participated in any Science Completions/ Fair/Exhibitions in the last one year?

Mentor Details:

First Name: RAHUL

Last Name: SHARMA

Email: rahul.sharma9505@gmail.com

Phone: 4698816621
