

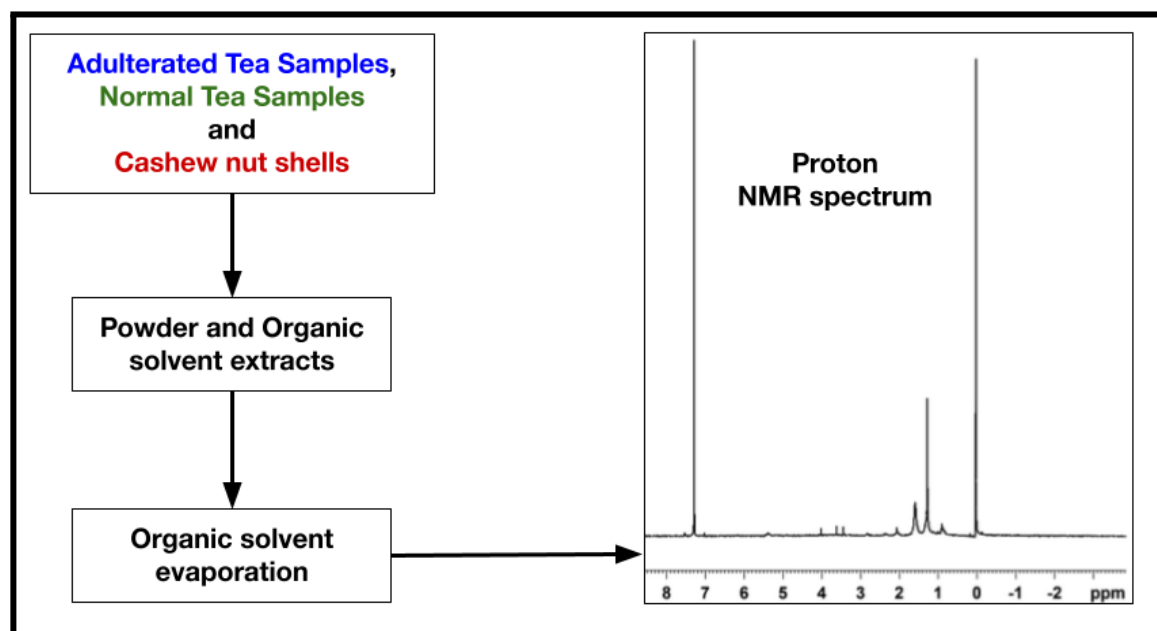
Proton NMR spectral data of adulterated tea samples suggest possible causes for various human gut-related diseases

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A cup of tea or coffee is quite common among several human beings across the world. On one hand, the corporate style tea maintains quality demanding high prices while the local brands are sold for cheap, sacrificing the quality. Decreased quality in the taste may not be a problem but if adulteration that may target the health of individuals takes place then it would pose a threat to human life. It has been in the news that saw/wooden dust, cashew nut shell powder and even iron fillings may be the common contaminants that have been detected in adulterated tea samples that have caused severe damages to the digestive system as well as the liver. In this study, we screened a few local tea samples along with the corporate tea sample to verify the adulteration of tea. Proton NMR spectra were obtained for each of these samples and were compared. Our study revealed shocking differences between the local tea samples compared to the branded tea sample. Further evaluation of these samples needs to be done in the future to confirm the contaminants in the tea.



Graphical abstract: Overall process of organic extractions using tea samples for proton NMR spectra.

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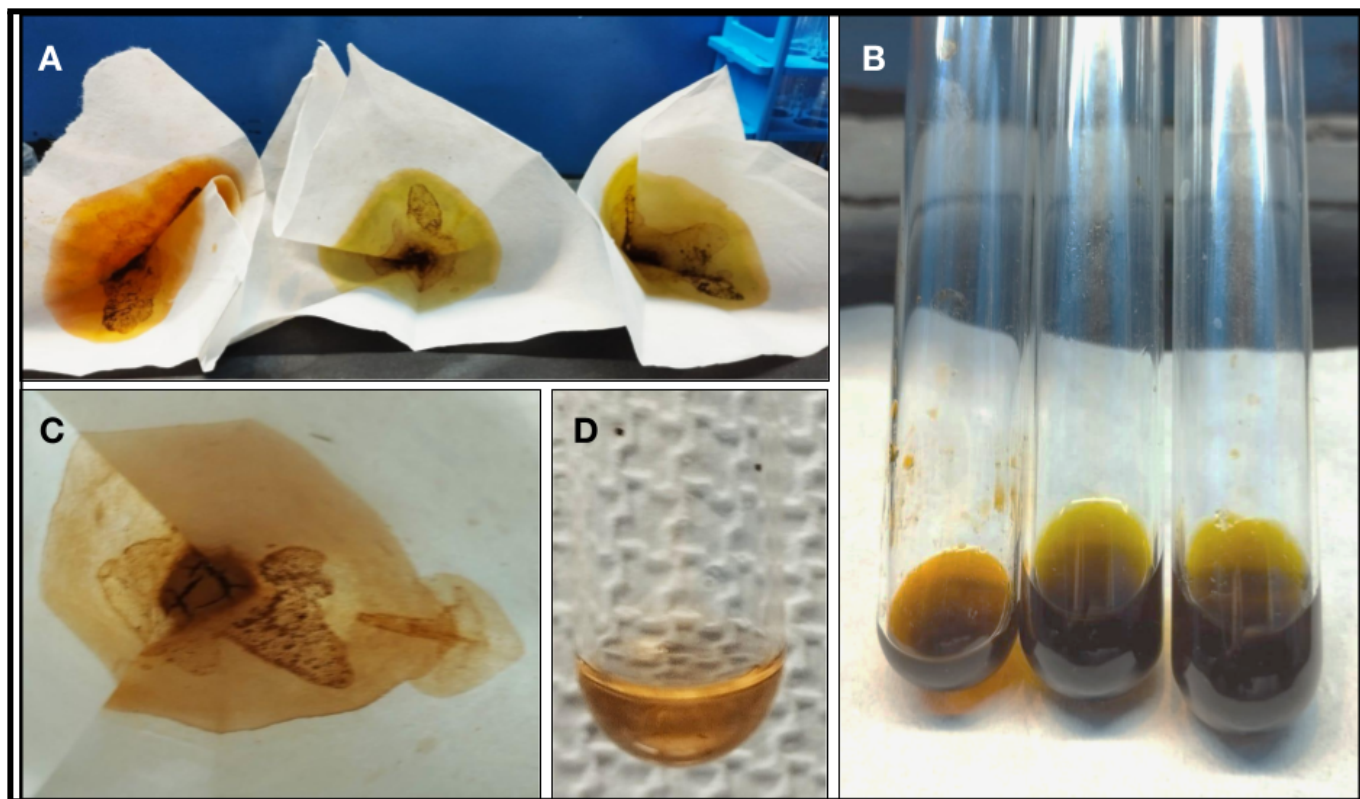


Figure 1. Methanol extractions and filtration of three local non-branded tea powders (panels A and B) and one branded tea powder (panels C and D) for proton NMR spectral acquisition. The local tea powder extracts showed red to green colors (panel A) while the branded tea powder extract showed brown color (panel C).

Chai is very common in India irrespective of the region within the country. Also known as tea, chai is also famous across the globe in various countries with various names and flavors. Typically obtained from the dried leaves powder, tea is available lavishly across the world although some countries depend on imports for the same. India is blessed with plenty of tea growing areas across the country that it always had an upper hand in the exports [1]. Unfortunately, tea adulteration has been a problem in various parts of India [2]. While some regions in India claim wood/saw dust as a contaminant, other regions claim the dried cashew nutshell powder as the contaminant within various local loose tea packings that are typically available in the markets to purchase. Households may follow alerts in buying such unbranded/unmarked tea packets but the road-side tea stalls and vendors on wheels may not care as much as the households do when it comes to the quality of the tea powder. Especially, with the add ons such as ginger, cardamon, other spices, etc., the road-side vendors do not care as much for the quality of the tea powder which not only helps them to gain more profits [3] but also at the same time

cause health hazards to the public that depends on these vendors for their daily routine cups of chai.

In this study, we were interested in comparing the proton NMR spectra of various local non-branded vs. branded tea powders. All samples were prepared by grinding the starting material into fine powder in a mortar with pestle followed by methanol extraction, filtration and solvent drying (Figure 1). As shown in Figure 1, the branded tea extract showed a typical brown color on the filter paper and also of the final extract while the non-branded loose tea powders showed red and green colors on the filter papers and in their final extracts. The final preparations were then submitted for the proton NMR spectral acquisition. As shown in Figures 2 and 3, the local non-branded tea spectrum showed additional peaks between 8 and 1 ppm. The total number of peaks observed in the branded tea was 7 (Figure 3) while the total number of peaks observed in the non-branded tea sample was 25 (Figure 2) which is more than 3-fold compared to the branded tea sample. These additional peaks in the non-branded tea sample can be attributed to either add ons such as ginger, cardamon, etc. or impurities that are responsible for the tea adulteration.

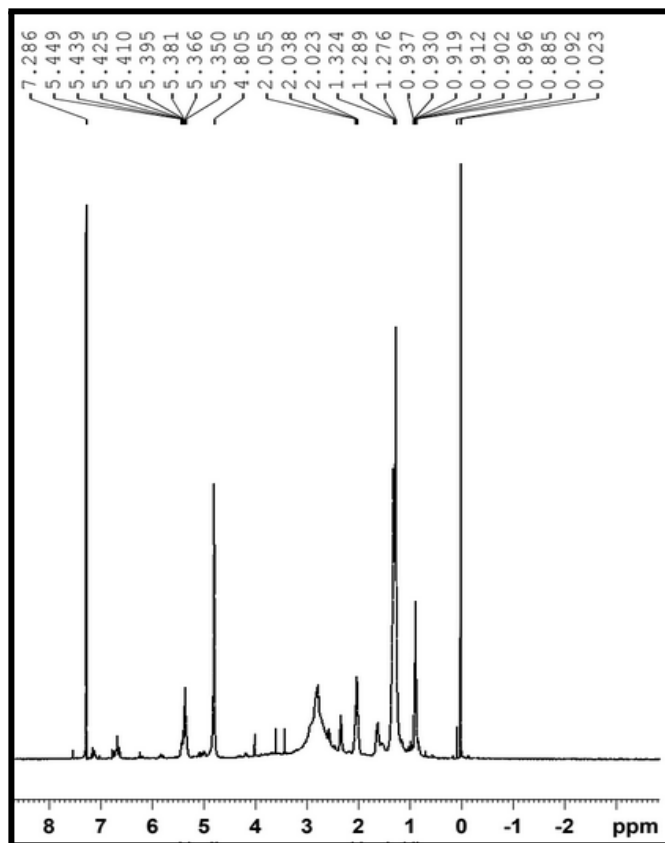


Figure 2. Proton NMR spectrum of adulterated tea powder extract.

Proton NMR spectral information for commonly added spices were obtained from the PubChem database to identify any of the spices being added to the non-branded tea sample. Although a very few of the peaks in Figure 2 (1 to 3) were identified as probable peaks from the spices the rest of peaks were not identified. These data suggest that the non-branded tea sample in this study did contain contaminants other than the commonly used spices. These contaminants will further be evaluated using the combination of NMR and LC/MS in future [4]. The contaminants may explain the reason for various gut-related disorders such as indigestion, acidity, etc. in addition to liver failure, diabetes, hypertension, etc.

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Conflict of interest: The authors declare no conflict of interest in this study. However, this research article is an ongoing project currently at TCABS-E, Visakhapatnam, India.

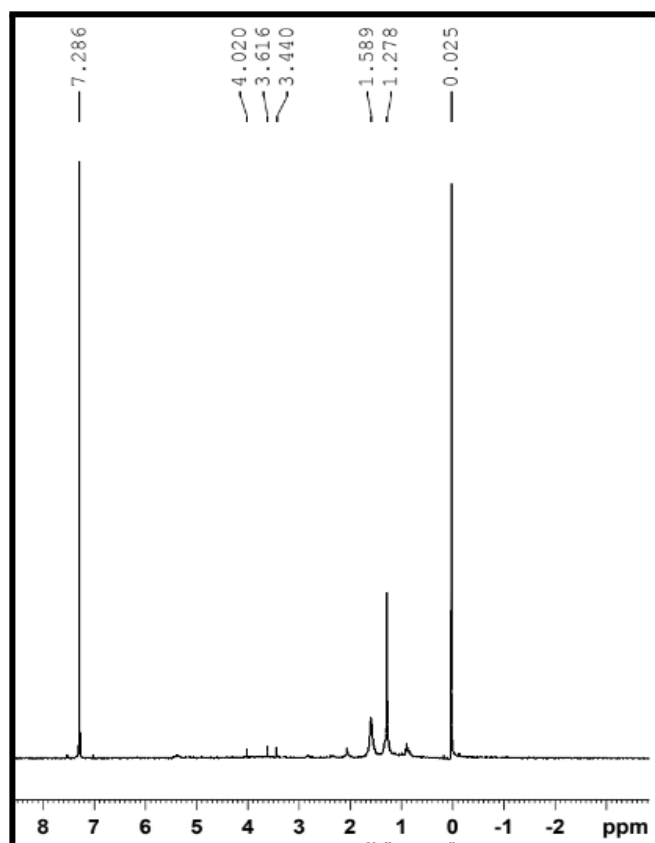


Figure 3. Proton NMR spectrum of branded tea powder extract.

Author contributions: R.T. collected the tea samples and prepared the extracts and NMR spectra with the help of J.Ch., M.S. and A.G. R.S.Y. is the principal investigator who designed the project, trained R.T., J.Ch., M.S. and A.G. in experiments, secured required material for the project, provided laboratory space, facilities needed and wrote/edited the manuscript.

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