

# **Potential for Elimination of Folate and Vitamin B<sub>12</sub> Deficiency in India Using Vitamin-Fortified Tea: A Preliminary Study**

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**Key Words:** Folate/Folic acid, vitamin B<sub>12</sub>, neural-tube defects, fortification, vehicle, tea, anemia

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## ABSTRACT

**Introduction:** The majority of Indian women have a poor dietary folate and vitamin B<sub>12</sub> intake resulting in their chronically low vitamin status, which contributes to anemia and the high incidence of folate-responsive neural-tube defects (NTDs) in India. Although many countries have successfully deployed centrally-processed folate-fortified flour for prevention of NTDs, inherent logistical problems preclude widespread implementation of this strategy in India. Because tea—the second commonest beverage worldwide [after water]—is consumed by most Indians every day, and appeared an ideal vehicle for fortification with folate and vitamin B<sub>12</sub>, we determined if daily consumption of vitamin-fortified tea for 2 months could benefit young women of childbearing-age in Sangli, India.

**Methods:** Women (average age = 20 ± 2 SD) used teabags spiked with therapeutic doses of 1-mg folate plus either 0.1-mg vitamin B<sub>12</sub> (Group-1, n=19) or 0.5-mg vitamin B<sub>12</sub> (Group-2, n=19), or mock-fortified teabags (Group-0, n=5) every day for 2 months, following which their pre- and post-intervention serum vitamin and hemoglobin concentrations were compared.

**Results:** Most women had baseline anemia with low-normal serum folate and below-normal serum vitamin B<sub>12</sub> levels. After 2 months, women in both Group-1 and Group-2 exhibited significant increases in mean differences in pre-intervention versus post-intervention serum folate levels of 8.37-ng/mL (95% Confidence Intervals (CI) 5.69 to 11.04, p<0.05) and 6.69-ng/mL (95% CI 3.93 to 9.44, p<0.05), respectively; however, Group-0 experienced an insignificant rise of 1.26-ng/mL (95% CI -4.08 to 0.16). In addition, over one-half and two-thirds of women in Group-1 and Group-2, respectively, exhibited increases in serum vitamin B<sub>12</sub> levels over 300-pg/mL. There was also a significant post-interventional increase in the mean hemoglobin concentration in Group-1 of 1.45-grams/dL (95% CI 0.64 to 2.26, p = 0.002) and Group-2 of 0.79-grams/dL (95% CI 0.11 to 1.42, p = 0.027), which reflected a bona fide clinical response.

**Conclusion:** Tea is an outstanding scalable vehicle for fortification with folate and vitamin B<sub>12</sub> in India, and has potential to help eliminate hematological and neurological complications arising from inadequate dietary consumption or absorption of folate and vitamin B<sub>12</sub>.

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**Statement of Corresponding Author**

As corresponding author, Dr. Antony had full access to all the data in the study and takes final responsibility for the decision to submit for publication. The article was approved by all contributors.

**Conflict of Interest Statement**

None of the authors have a personal conflict of interest with this paper.

**Authors' contributions to the manuscript**

Ravindra M. Vora, FRCS(Edin), developed, designed and facilitated the study, recruited subjects, prepared vitamin-fortified tea, coordinated blood testing of subjects, collected and compiled data, revised the paper, and was responsible for study oversight.

Meryl J. Alappattu, PhD, prepared figures, analyzed the data, and performed statistical analysis.

Apoorva D. Zarkar, MBBS, prepared vitamin-fortified tea, recruited subjects, and helped collect data.

Mayur S. Soni, MBBS, prepared vitamin-fortified tea, recruited subjects, and helped collect data.

Santosh J. Karmarkar, MCh, developed, designed and facilitated the study.

Aśok C. Antony, MD, MACP, conceived, developed, designed and facilitated the study, prepared vitamin-fortified tea, analyzed data, wrote the paper, and is primarily responsible for the final content of the paper.

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