

## Soapstone utensils may improve iron status in adult women. A preliminary study

*Kesia Diego Quintaes, Niurka Maritza Almeyda Haj-Isa, José Trezza Netto, Jaime Amaya-Farfan*

Ouro Preto Federal University, Ouro Preto, MG, Brazil. University of Campinas, Campinas, SP, Brazil.  
Oswaldo Cruz College, Oswaldo Cruz, SP, Brazil

**SUMMARY.** Soapstone is among the first heat-resistant materials to have been used by man for the manufacture of culinary utensils, but its impact on human nutrition has merited little attention. Here, we present a preliminary evaluation of the impact of soapstone pans on the iron status in humans. Five nuns ( $37.6 \pm 6.31$  y) replaced the soapstone for their traditional aluminum cookware, without any alteration of the diet itself. Comparison of the hematological data, determined before and 10 weeks after switching the pans, revealed that hemoglobin rose from  $13.26$  to  $14.0$   $\text{mg}\cdot\text{dL}^{-1}$  ( $p=0.0048$ ), and hematocrit increased from  $38.14$  to  $40.71\%$  ( $p=0.0002$ ), while the transferrin saturation index went from  $28.04$  to  $28.96\%$  ( $p=0.0147$ ) and ferritin, from  $31.5$  to  $34.74$   $\mu\text{g}\cdot\text{L}^{-1}$  ( $p=0.0681$ ). By simply replacing the soapstone for the traditional aluminum cookware, substantially improved the iron status in all subjects in a relatively short period of time.

**Key words:** Nutritional status, anaemia, iron migration, aluminium, pans, cookware

**RESUMEN. Utensilios de piedra-jabón pueden mejorar el estado nutricional en hierro de mujeres adultas. Estudio preliminar.** La piedra-jabón (jabón-de-sastre, piedra de talco), uno de los primeros materiales termo-resistentes usados en la manufactura de utensilios culinarios, ha recibido poca atención sobre el impacto de su uso en el estado nutricional de la población. El presente estudio piloto evalúa el uso de utensilios de piedra-jabón en el estado nutricional en hierro de mujeres jóvenes. Cinco monjas ( $37,6 \pm 6,31$  años) reemplazaron sus tradicionales utensilios de aluminio por ollas de piedra-jabón, sin cualquier otra alteración en la dieta. La comparación de los parámetros sanguíneos, determinados antes y después de 10 semanas de intervención, mostró que la hemoglobina aumentó, de  $13,26$  a  $14,00$   $\text{mg}\cdot\text{dL}^{-1}$  ( $p=0,0048$ ) y el hematocrito, de  $38,14$  a  $40,71$  ( $p=0,0002$ ), mientras el índice de saturación de transferrina subió, de  $28,04$  a  $28,96\%$ , y la ferritina, de  $31,50$  a  $34,74$   $\mu\text{g}\cdot\text{L}^{-1}$  ( $p=0.0681$ ). Se concluye que mediante la simple eliminación de los utensilios de aluminio y su substitución por los de piedra-jabón, posibilitó una substancial mejoría del estado nutricional en hierro de todos los sujetos, en un término relativamente corto.

**Palabras clave:** Estado nutricional, anemia, migración de minerales, suplementación mineral, aluminio, ollas

### INTRODUCTION

Due to its abundance and rather plastic properties, steatite, or soapstone, has been used by man since remote times (1). During early history, wood, bone and rocks were used to dug out steatite stone, which because of its high density, softness and resistance to heat, proved to be ideal for carving pans and sculptures (2,3). Although the soapstone chemical composition is known to vary according to geographic location, talc and chlorite are its chief crystal components, and the calcium, magnesium and iron are known to be constituents (2-5). The chemical and thermal resistance of steatite is determined by environmental, petrographic and petrophysical conditions of the material (1,4). Acid media are detrimental to the stone structure in all

cases and some kind of curing is recommended in order to minimize loss of mass, while extending its durability (1,4-6).

Even after cured, steatite pans are capable of transferring minerals, including nutritionally important elements such as calcium, iron, magnesium and manganese to the food material (5,7). Since data on the bioavailability of these minerals are not found in the literature, the purpose of this investigation was to assess the impact of adopting the routine preparation of meals in steatite cookware on women's iron status.

### MATERIALS AND METHODS

Three small convents of the state of Minas Gerais, where soapstone cookware is manufactured, were in-

vited to participate in the trial. Criteria for inclusion were: i) age (30-45y), ii) regular oestral cycles, iii) good health condition, iv) absence of surgical interventions within the preceding six months, v) absence of nutritional supplement treatments. Eight nuns who met the criteria agreed to join the study and received instructions following the protocol of the institutional Ethics Committee (University of Campinas, n°317/2001).

Eighteen new soapstone pans of different sizes (2.5, 3.5, 5L) were acquired in Ouro Preto (MG, Brazil), cured as previously described (4) and distributed among the institutions to replace the usual aluminum cookware. For 10 consecutive weeks, the nuns were asked to follow a do-nots list (abstaining from interfering utensils, supplements or unusual foods). Before the end, three participants were excluded because of failure to adhere to the list. Switching pans allowed each subject to be considered as her own control.

Standard analytical methods were used for the determination of haematological variables. Two 5-mL blood samples were collected, one with anticoagulant (EDTA), for hemoglobin (Hb) and hematocrit (Ht), and another without, for ferritin, serum iron (SI), total iron binding capacity (TIBC) and transferrin saturation index (TSI). The haemograms were determined in an automatic Coulter SKTS analyzer (Coulter Corporation), serum ferritin by chemiluminescence in an ACS180 Plus instrument (Bayer Corporation), and serum iron and TIBC by the method of Goodwin, modified with the introduction of a semi-automatic photometer Humalyzer 2000 (Human Corporation).

Individual values were considered normal if Hb  $\geq 12\text{g}\cdot\text{dL}^{-1}$ , Ht  $\geq 36.0\%$  and serum ferritin  $>15\text{-}150\mu\text{g}\cdot\text{L}^{-1}$  (7). The serum iron and TIBC normal values were those described by Yip and Dallman (8). Body Mass Indices (BMI) were calculated from the referred weight and height data, and the results used to classify the participants in underweight, overweight and obese, applying the cut-off line of the World Health Organization (9).

The impact of the intervention was evaluated by the concentrations of the response variables. For the evaluation of differences between the treatments and data of the haematological parameters, analysis of variance (ANOVA) was used, and the criterion of  $p < 0.05$  was applied when comparing the means by the Tukey test.

## RESULTS

Adoption of soapstone cooking was considered successful, because of the thermal inertia, ease of cleansing and added sensorial characteristics of the food. After the study the nuns declared intentions to continue using the cookware.

Of the five nuns concluding the trial, one was overweight (BMI =  $27.8\text{kg}\cdot\text{m}^{-2}$ ) and one mildly underweight ( $16.9 \leq \text{BMI}; 18.4\text{kg}\cdot\text{m}^{-2}$ ). A state of iron depletion was detected in the subject with the lowest BMI at the start, while the other showed a decrease of 3kg BW and mild iron depletion at the end. Neither of the subjects exhibited anemia at any time.

Comparing the initial with the final haematological data, increases were observed for Hb (5.6%,  $p=0.0048$ ), Ht (6.7%,  $p=0.0002$ ) and serum ferritin (10.3%,  $p=0.0681$ ), the latter being the most specific biochemical test correlating with the relative total body iron stores, particularly in females (7). No case of hypoferritinemia was observed (Table 1).

Serum iron and TSI also showed increases in all subjects ( $p=0.009$  and  $0.014$ , respectively). The levels

TABLE 1  
Average values ( $\pm$ SD) of the subjects' haematological indicators before and after inclusion of soapstone pans in food preparation.

Parameters	Average values ( $\pm$ SD)		p
	Before	After	
Hemoglobin ( $\text{mg}\cdot\text{dL}^{-1}$ )	13.26 ( $\pm 0.91$ )	14.00 ( $\pm 0.79$ )	0.0048*
Haematocrit (%)	38.14 ( $\pm 1.84$ )	40.71 ( $\pm 1.86$ )	0.0002*
TSI (%)	28.04 ( $\pm 8.25$ )	28.96 ( $\pm 9.85$ )	0.0147*
Transferrin ( $\text{mg}\cdot\text{mL}^{-1}$ )	200.60 ( $\pm 22.87$ )	213.60 ( $\pm 14.62$ )	0.2670
Serum iron ( $\mu\text{g}\cdot\text{L}^{-1}$ )	79.60 ( $\pm 21.36$ )	86.00 ( $\pm 32.19$ )	0.0096*
TIBC ( $\mu\text{g}\cdot\text{L}^{-1}$ )	286.40 ( $\pm 32.41$ )	294.40 ( $\pm 16.92$ )	0.4292
Serum ferritin ( $\text{mg}\cdot\text{L}^{-1}$ )	31.50 ( $\pm 18.23$ )	34.74 ( $\pm 19.97$ )	0.0681

TSI: Transferrin saturation index

TIBC: Total iron-binding capacity

SD: standard deviation

\* values with statistical difference between before and after intervention ( $n=5$   $p < 0.05$ )

of TIBC, index that rises in states of iron deficiency, were considered normal ( $250\text{-}390\mu\text{g}\cdot\text{dL}^{-1}$ ) and remained unaltered. Similarly, the serum values of transferrin of all the subjects did not show significant changes ( $p=0.2669$ ).

## DISCUSSION

The prevalence of iron deficiency among adult women can reach up to 29.7% (10) and iron deficiency anemia among Brazilian women (20 to 60y) can be around 19.2% (11). In addition, Hb, Ht, ferritin and TSI values in Italian women ( $24\pm 5y$ ) were slightly lower than those reported here,  $12.8\text{ g}\cdot\text{dL}^{-1}$ ; 38.1%;  $26.0\mu\text{g}\cdot\text{L}^{-1}$  and 26.7%, respectively, while serum iron and transferrin were higher,  $92.0\mu\text{g}\cdot\text{dL}^{-1}$  and  $256.0\text{mg}\cdot\text{dL}^{-1}$  (10).

A Brazilian study involving the use of iron cookware by ovo-lacto-vegetarians for 12 weeks detected a significant decrease of iron anemia from 32.1 to 5.3%, while prevalence of haematologically normal individuals increased, from 41.0 to 67.8%, pointed out that iron pans are a good alternative to treat and prevent iron anemia (12). However, rice prepared in glass, soapstone and cast iron pans has 2.5, 3.5 and 8.7% iron, respectively, and 12, 14 and 55% for tomato sauce, respectively (6). Even considering the lower Fe-transferring power of steatite, this alternative bears the advantage of being more economical and rendering an appealing flavor to the food, compared to cast iron.

Studies have reported that avoidance of uncoated aluminum cookware in the preparation of meal of patients with chronic renal disease reduced plasma aluminum levels (13,14), which in turn was positively correlated with an increase of circulating iron and TSI (13). Although the blood aluminum levels were not determined in our study, it was not possible to detect if the sole removal of aluminum utensils had any effect on iron absorption, as suggested by researchers (13). Upon termination of the intervention, no health interferences were reported that could be attributed to the use of the stoneware.

## CONCLUSIONS

Even in the absence of anemia or iron deficiency, complete replacement of soapstone for the traditional aluminum cookware for 10 weeks was sufficient to

produce a substantial improvement of the subjects' iron status. The possibility that removal of the aluminum cookware could have contributed to the final result, cannot be excluded and constitutes a research target that should be pursued.

An obvious limitation of the present study is related to the difficulty of securing a large enough number of volunteers, with a disciplined way of life, and that are likely to adhere to an in-house meal plan for a reasonable length of time, so that farther reaching conclusions could be drawn. Nevertheless, besides the above, this preliminary study has also served to rekindle the issue of mineral antagonisms, such as that between aluminum and iron.

## ACKNOWLEDGMENTS

To the nuns who participated in the study and to Bayer do Brasil, Becton-Dickinson, Cremer S.A., In-Vitro Diagnóstica and Álamo Centro Diagnóstico for the support given.

## REFERENCES

1. Storemyr P. Weathering of soapstone in a historical perspective. *Mater Character* 2004;53:191-207.
2. Magee P, Barber D, Sobur M, Jasim S. Sourcing Iron Age softstone artefacts in Southeastern Arabia: results from a programme of analysis using Inductively Coupled Plasma-Mass Spectrometry/Optical Emission Spectrometry (ICP-MS/OES). *Arab Arch Epig* 2005;16:129-143.
3. Farias RF. An investigation of the chemical composition and acid corrosion of pedrasabão (soapstone). *J Serb Chem Soc* 2005; 70:261-268.
4. Quintaes KD, Amaya-Farfan J, Morgano MA, Mantovani DMB. Soapstone (steatite) cookware as a source of minerals. *Food Addit Contam* 2002;19:134-143.
5. Namdar D, Stacey RJ, Simpson SJ. First results on thermally induced porosity in chlorite cooking vessels from Merv (Turkmenistan) and implications for the formation and preservation of archaeological lipid residues. *J Arch Sci* 2009; 36:2507-2516.
6. Quintaes KD, Amaya-Farfan J, Tomazini FM, Morgano MA. Migração de minerais de panelas brasileiras de aço inoxidável, ferro fundido e pedra-sabão (esteatito) para preparações culinárias. *Arch Latinoam Nutr* 2006; 56:275-281.
7. World Health Organization. Iron deficiency anaemia: assessment, prevention, and control. A guide for programme managers. Geneva, World Health Organization, 2001.

8. Yip R, Dallman PR. Iron; in: E Ziegler, J Filer (eds): *Current Knowledge of Nutrition*, ILSI Press, 1996, pp. 277-292.
9. World Health Organization. Physical status: the use and interpretation of anthropometry. Expert Committee. *World Health Org Tech Rep Ser* 1995; 854:1-452.
10. Casabellata G, Santolo M, Banfi G, Stel G, Gonano F, Cauci S. Evaluation of iron deficiency in young women in relation to oral contraceptive use. *Contraception* 2007; 76:200-207.
11. Fabian C, Olinto MTA, Dias-da-Costa JS, Bairros F, Nácúl LC. Prevalência de anemia e fatores associados em mulheres adultas residentes em São Leopoldo, Rio Grande do Sul, Brasil. *Cad Saúde Pública* 2007; 23:1199-1205.
12. Quintaes KD, Amaya-Farfan J, Tomazini FM, Morgano MA, Haj-Isa NMA. Mineral migration and influence of meal preparation in iron cookware on the iron nutritional status of vegetarian students. *Ecol Food Nutr* 2007;46:125-141.
13. Lin JK, Yang YJ, Yang SS, Leu ML. Aluminum utensils contribute to aluminum accumulation in patients with renal disease. *Am J Kid Dis* 1997;30:653-658.
14. Neelam S, Bamji MMS, Kaladhar M. Risk of increased aluminium burden in the Indian population: contribution from aluminium cookware. *Food Chem* 2000;70:57-61.

Recibido: 08-07-2011

Aceptado: 12-01-2012