DOI: 10.12957/demetra.2016.17413

Evaluation of use and cost of soybean oil in the production of rice and beans in a university restaurant

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Abstract

Objective: The study aimed to evaluate the amount and cost of soybean oil used in the preparation of rice and beans, comparing them with the technical specifications and guidelines by the World Health Organization and the *Food Guide for the Brazilian Population* (2006). *Methods:* Data was collected during 15 days in a university restaurant by measuring the difference between the amount of oil used in lunch preparation and the total amount of oil contained in cans of 18 liters used daily. For comparing the oil consumption costs between the quantity used and the quantity determined by the technical specifications, we used the price paid in the month for 18-liter oil cans. *Results:* The results showed variations in the quantities of oil, which corresponded on average to 0.29 ± 0.10 (l) and 0.99 ± 0.42 (I) for 10 kg of raw beans and rice, respectively. Such variations indicate a statistically significant difference ($p < 0.05$) for both dishes. Regarding the preparation cost, there was a significant increase ($p < 0.05$) when comparing it with the data sheet values, with an average variation of R $ 0.94 and R $ 1.96 for the production of 10 kg of raw beans and rice, respectively. The quantity of oil contained in the rice portions (5.4 ml) and bean (2.5 ml) was also high as compared to the daily consumption recommendations of oils and fats by the World Health Organization (16ml / day) and the *Food Guide for the Brazilian Population* (8 ml / day). *Conclusion:* The Food Data Sheet is key for controlling costs in meals production, and the amount of oil used in the preparation of rice and beans is greater than recommended, so a training program is necessary to standardize the production of meals according to the data sheet specifications.

Key words: Food Service. Soybean oil.

Introduction

The change in eating habits observed in this century is directly related to the preference for a Western diet, which accounts for an increased consumption of highly caloric, fatty foods, while the intake of fruits, vegetables and grains has decreased. Such diets, associated with a progressive reduction of physical activities, a key factor observed in today's population, leads to a higher incidence of noncommunicable chronic diseases (NCD), the four main ones being cardiovascular diseases, cancer, chronic respiratory disease and diabetes.[1,2]

Diets rich in fats, especially saturated fats, increase the LDL-c/HDL-cO ratio especially by the intake of partially-hydrogenated or interesterified soybean oil, and is traditionally related with a rise of plasmatic LDL-c and an increase of cardiovascular risk. Thus, substitution of saturated fat in the diet with mono- and poly-unsaturated fat, or a reduction in consumption, may be considered strategies for a better control of hypercholesterolemia, with consequent reduction of the chances of occurrence of clinical events.[3]

Despite the harmful effects of inadequate diets, it is important to note that oils are important in human nutrition because they contribute to the energy that is required to meet the daily nutritional needs, contain liposoluble vitamins, are rich in unsaturated fatty acids (oleic, linoleic and alfa-linoleic acids) and poor in saturated fatty acids.[4,5] Also, they provide sensory features of high consumer's acceptability.[4,6,7]

According to data of the Brazilian Institute for Geography and Statistics (2008-2009),[8] it is estimated that in large Brazilian centers around 30% of the meals are eaten out of the home and that population spends on average 33.1% of food expenses with this kind of meal.[8] According to the Survey on Brazilian Eating Habits conducted in 2006 in ten Brazilian cities with more than one million people each, with individuals aged between 17 to 65 years, 94% of the respondents reported that they usually eat rice and bean.[9]

The meals' nutritional adequacy, whether homemade or eaten outside the home, should consider nutritionally balanced meal components, which, when consumed in excess, may cause damages to the human health.

To build and deliver a nutritionally balanced diet in food services units, the nutritionists' role is of great impact since their duties include the menu planning to meet the individuals' nutritional needs, supervision of the staff during meals preparation and cooking, as specified in the food datasheets, and assessment of the services provided.[10]

Considering these duties, this study aimed to quantify the use and cost of soybean oil used for cooking rice and bean at an institutional food service.

Material and methods

The study was conducted at a university cafeteria located in Belo Horizonte-MG, which operates under a governmental financial subsidy system, with special prices according to the users' socioeconomic category, a condition that requires that users have some kind of bond with the university or be a visitor.[11]

The cafeteria serves around 3,600 meals per day (lunch and dinner). The number of users vary according to the week day, with an average number of 2,900 people for lunch and 700 for dinner. The serving hours are from Monday to Friday (except holidays), from 11a.m. to 2 p.m. and 5:30 p.m. to 7 p.m. On Saturday (except holidays), meals are served from 11:30 a.m. to 1 p.m. The menus, both for lunch and dinner, comprise main dish (three options), side dish, salad, dessert, rice and bean and juice. The serving meals system is self-service, or buffet-type service, except for the main dish and side dish, which are served by two attendants of the food service.[11] The target public is mostly comprised of students and, in less number, employees of the university, foundations and support agencies.[11]

The quantification of the soybean oil used for cooking rice and bean was made at lunch time during a 15-day period in May 2014. Triplicate measurements were taken (during three non-consecutive days) for 10 kg of raw (uncooked) grains and compared to the food service's datasheet (specifications for foods preparation) and the recommended daily intake of oils and fats by international and national health agencies. In addition, the cost variation between the amount of oil as specified in the datasheet and the amount used for cooking the rice and bean portions was calculated.

To weigh the raw and cooked grains quantities, a digital scale with a maximum capacity of 500 kg/100, a 1000-ml plastic beaker with 5-ml graduation and two 18-liter cans of oil were used, one empty to be used for the transfer of oil during measurements and the other identified to be used for preparation of rice and bean.

In order to avoid possible biases in measurement, the operators were instructed to use the oil as they usually did before the study, but using the identified cans. After cooking the rice and beans, the oil that remained in the identified cans was measured using the plastic beaker. The difference between the oil that remained in the cans and the capacity of each can (18 liters) was used to determine the quantity of oil used in both dishes.

To calculate yields, the Cooking Factor (Fy),[10,12] was used, and these values were used later to determine the quantity of oil per serving size of each dish at each day of measurement, according to the *Food Guide for the Brazilian Population* [13] and the World Health Organization (WHO).[14]

Comparison of the data obtained with the Food Data Sheet (FDS) specifications was made using the *Tecfood* software (Teknisa®), 4.09.069 version, with analysis of variance ($p<0.05$). To compare the oil consumption costs between the quantity used and the quantity specified in the FDS, it was adopted the price of 18-liter oil can, as paid to the supplier on May 2014 (R$ 57.50).[15]

The study was approved by the technician responsible for the operations of the the university cafeteria.

Results

The results described in Tables 1 and 2 show that the consumption of oil was higher than the quantity specified in the FDS, both for beans and rice, with significant difference ($p<0.05$).

Table 1. Amount of soybean oil used in the preparation of beans compared to the university cafeteria's Food Data Sheet. Belo Horizonte, 2014.

Average quantity as specified in the Food Data Sheet (l)	Quantity of soybean oil used (l)	Variation between both measures (l)
0.23	0.63	0.40
	0.42	0.19
	0.54	0.31
Average:	0.53	0.30
SD:	0.09	0.09

*Triplicate measurements. There was significant statistical difference ($p<0.05$).

Table 2. Quantity of soybean oil used in the preparation of rice compared to the university cafeteria's Food Data Sheet. Belo Horizonte, 2014.

Average quantity as specified in the Food Data Sheet (l)	Quantity of soybean oil used (l)	Variation between both measures (l)
0.26	0.70	0.44
	1.05	0.79
	1.00	0.74
Average:	0.91	0.66
SD:	0.15	0.15

*Triplicate measurements. There was significant statistical difference ($p<0.05$).

The results indicated a higher cost in the use of soybean oil for cooking rice and beans compared to the FDS (Tables 3 and 4). These results had a significant difference for both dishes ($p< 0.05$).

Table 3. Daily costs of soybean oil used in the preparation of beans compared to the university cafeteria's Food Data Sheet. Belo Horizonte, 2014.

Total average cost of soybean oil according to the Food Data Sheet	Total preparation cost	Cost variation
R$ 0.73	R$ 2.01	R$ 1.28
	R$ 1.34	R$ 0.61
	R$ 1.72	R$ 0.99
Average:	R$ 1.69	R$ 0.96
SD:	0.27	0.27

Table 4. Daily cost of soybean oil used in the preparation of rice compared to the university cafeteria's Food Data Sheet. Belo Horizonte, 2014.

Total average cost as specified in the Food Data Sheet	Total preparation cost	Cost variation
R$ 0.83	R$ 2.24	R$ 1.41
	R$ 3.35	R$ 2.52
	R$ 3.19	R$ 2.36
Average:	R$ 2.92	R$ 2.10
SD:	0.49	0.49

Based on the reference data contained in the *Food Guide for the Brazilian Population*[13] and by WHO,[14] it was possible to compare the quantity of soybean oil contained in each portion of rice and bean (lunch and dinner). The data obtained showed a high amount of oil per rice and bean portion, respectively, if compared to the daily amounts recommended for all meals served in a day (Figure 1).

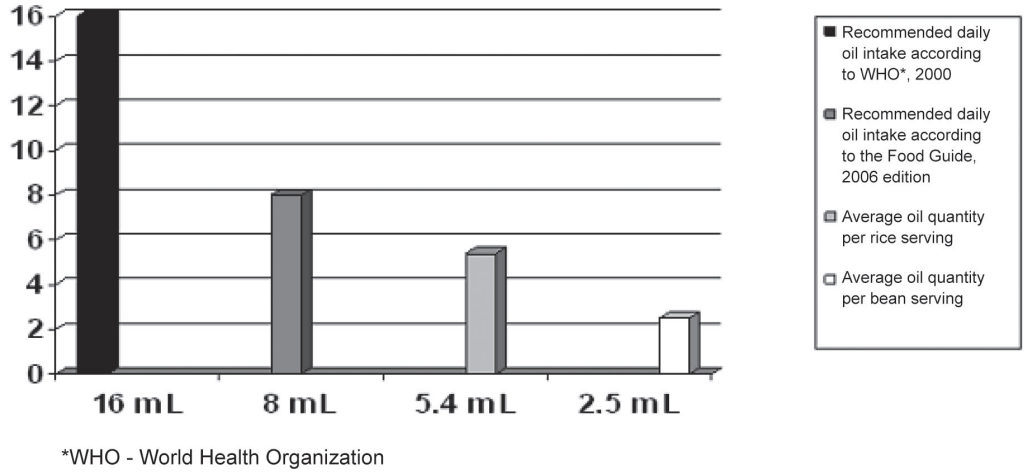

Figure 1. Comparison of the average quantity of soybean oil used for preparation of rice and beans with the total recommended daily consumption of oils and fats. 2000.

Discussion

A significant difference ($p<0.05$) was found between the average quantity of soybean oil used for cooking bean and rice and the quantity specified in the FDS. The variations in soybean oil quantities corresponded on average to 0.30 ± 0.09 (l) for bean and 0.66± 0.15 (l) for rice per 10 kg of raw grain if compared to the FDS (Tables 1 and 2). Although the study was not intended to determine the centesimal composition of total lipids in the preparations, it is known that such values increase considerably as the quantity of lipids in the food increases, due to greater absorption by the grains depending on the dish made.[4,16]

It is important to adopt nutritional criteria when planning the menu in order to establish the total energy value of the meals and the percent rates of calories from proteins, lipids and carbohydrates in a meal,[17] given that an increase of any element in a dish may contribute to an inappropriate increase in the energy value.

With respect to the nutritional aspects, an increased intake of soybean oil may contribute to an increased intake of total daily fats, contributing to an increase in body adiposity as well as a strong association with noncommunicable degenerative chronic diseases.[18]

Standardizing the quantity of soybean oil used for cooking rice and bean, at 8% and 5%, respectively, in relation to raw grain, would be the ideal solution.[4] In the present study, it was found that 9.1% of oil on average was used for cooking rice and 5.3% for bean in relation to the raw grain. Such values are above the optimal level suggested,[4] both for rice and beans, with a difference of 1.2% and 0.3%, respectively. In a study that compared the sensory characteristics (flavor, aroma and texture) of the foods served in a self-service restaurant, it was found that standardizing the oil quantity as 2% for cooking rice and bean did not have any impact on the food evaluation and consumption.[4]

Comparing the results obtained with the values recommended by the *Food Guide for the Brazilian Population* [13], it was observed that the average amount of oil (ml) per rice serving (125g – one full serving spoon) and bean serving with 50% broth (86 g – one ladle) represented about 67.5% (5.4 ml) for rice and about 31.2% (2.5 ml) for bean of the total recommended daily intake of fats and oils (8 ml/day).

Concerning the WHO's data[14], which prescribes daily intake of oils and fats up to two serving sizes (16ml/person – one full tablespoon),[5,14] the average values found in this study for rice and bean servings corresponded to about 33.7% (5.4 ml) and 15.6% (2.5 ml) of the recommended values (Figure 1).

Total oil intake by an individual depends on the amount consumed and the number of dishes of a meal.[8] It is known that the combination of rice and bean is associated with Brazilians' traditional eating habits, even when eating outside the home,[19] usually consuming more than one serving of these foods in the main meals (lunch and dinner). This makes us believe that the quantity of oil consumed per day by the users of this cafeteria is above the recommendation and, for this reason, it is necessary to review its production procedures.

The results found in this study are similar to those reported by Fausto et al.,[20] when they determined the profile and the nutritional status of the consumers and the chemical and nutritional composition of the meals (lunch and dinner) provided by a university cafeteria in the São Paulo State University in Araraquara. The data indicate quantities above the recommended levels for lipids, which account for an increased energy value, not only the lipids contained in animal source foods but also the lipids added via cooking and frying.

Monteiro et al.[5] assessed the quantity of soybean oil at a university cafeteria in Belo Horizonte-MG and observed that the value found was below the levels prescribed by WHO. However, as in this study, if the other meals of the day were taken into account, there might have been an excess in the daily recommended values.

Other study that analyzed the nutritional composition and costs of raw material of dishes served in pay-by-weight restaurants in Goiânia-GO concluded that the percentage of salt and oil used in white rice and bean portions was above the levels recommended by the literature. As a result, it was found that the lack of standardization in preparation and cooking resulted in differences in the production costs and in the nutritional composition of the dishes assessed in the restaurants.[21]

Bandoni et al.[22] evaluated the quality of meals provided to workers in the city of São Paulo and concluded that the meals eaten at the workplace had less energy density, more fibers density and a higher rate of vegetables, fruits and legumes compared to the meals produced at home. On the other hand, the meals eaten in commercial restaurants resulted in a higher intake of sugars and sweets, as well as fats and oils, when compared to homemade meals.

Bezerra and collaborators[23] analyzed the characteristics of consumption of foods outside the home in Brazil and found that the food groups with higher rate of consumption out of the home were alcoholic beverages, deep fried and baked pastries/snacks, sodas and sandwiches, that is, predominance of high calorie foods and poor in nutrients.

The parameters assessed in this study allow to emphasize the importance of use and standardization of the FDS as an instrument of control, which benefits the whole production process because it facilitates the work of the technical staff, allows controlling the nutritional value

of the meals served and represents an operational support in costs determination.[24,25] Thus, it enables standardizing the meals, a key factor in the control of the amounts of ingredients used for preparation of the dishes.[24] In addition to the nutritional aspects, a reduction in the use of soybean oil for cooking to meet the FDS requirements also contributes to costs reduction.

It was observed costs variation compared to the FDS for cooking rice and bean, of R$ 0.96 and R$ 2.10 on average, for the production of 10 kg of raw food. The costs of the dishes were 2.3 and 3.5 times higher than the costs described in the FDS for bean and rice, respectively (Tables 3 and 4), with significant difference ($p<0.05$) for both. It was not found in the literature comparative data for the costs of soybean oil used in each dish made.

Based on this analysis, it is emphasized the importance of the FDS in food service units. The main limitation of this study refers to the assessment of soybean oil only used for cooking rice and bean.

Conclusion

Thus, it can be concluded that the amount of soybean oil used for preparation of rice and bean is high, according to the cafeteria's FDS and recommendations of WHO and *Food Guide for the Brazilian Population*. Furthermore, although the average quantity of soybean oil provided by the university cafeteria is lower than WHO's recommended levels, such value may not reflect the users' actual intake if one considers the other foods containing fats that are eaten in the same day.

It was also possible to observe that the use of a less quantity of oil may represent a reduction of the monthly costs in the purchase of this ingredient by the cafeteria.

It is recommended to train the operators of this cafeteria and emphasize the importance of the FDS as a tool to promote the users' health.

References

1. Duncan BB, Chor D, Aquino EML, Bensenor IM, Mill JG, Schmidt MI, et al. Doenças crônicas não transmissíveis no Brasil: prioridade para enfrentamento e investigação. Rev. Saúde Publica 2012; 46(Suppl 1):126-134.
2. Mariath AB, Grillo LP, Silva RO, Schmitz P, Campos IC, Medina JRP, et al. Obesidade e fatores de risco para o desenvolvimento de doenças crônicas não transmissíveis entre usuários de unidade de alimentação e nutrição. Cad. Saúde Pública 2007; 23(4):897-905.

3. Santos RD et al. Sociedade Brasileira de Cardiologia. I Diretriz sobre o consumo de Gorduras e Saúde Cardiovascular. Arq. Bras. Cardiol. 2013; 100(1 Supl.3):1-40.

4. Amorim MMA, Junqueira RG, Jokl L. Consumo de óleo e gordura nas preparações do almoço self service. Alim. Nutr. 2010; 21(2):217-223.

5. Monteiro MAM, Calixto CFS, Azevedo JFM, Schaefer MA. Avaliação da quantidade de óleo de soja em refeições oferecidas em um restaurante universitário. Demetra: Alimentação, Nutrição e Saúde 2013; 8(1):53-61.

6. Cella RCF, Regitano-D'arce MB, Spoto MHF. Comportamento do óleo de soja refinado utilizado em fritura por imersão com alimentos de origem vegetal. Cienc. Tecnol. Alim. 2002; 22(2):111.

7. Jorge N, Janieri C. Avaliação do óleo de soja utilizado no restaurante universitário do IBILCE/UNESP. Alim. Nutr. 2004; 15(1):11-16.

8. Instituto Brasileiro de Geografia e Estatística. Pesquisa de orçamentos familiares 2008-2009: despesas, rendimentos e condições de vida. Rio de Janeiro: IBGE; 2010. [acesso em: 02 nov. 2012]. Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pof/2008_2009/POFpublicacao.pdf.

9. Barbosa L. Feijão com arroz, arroz com feijão: o Brasil no prato dos brasileiros. Horiz. Antrop. 2007; 13(28):87-116.

10. Amorim MMA, Junqueira RG, Jokl L. Adequação nutricional do almoço self service de uma empresa de Santa Luzia, MG. Rev. Nutr. 2005; 18(1):145-156.

11. Fundação Mendes Pimentel. Alimentação. Restaurantes universitários [Internet]. Belo Horizonte: Fump, UFMG. [acesso em: 13 maio 2014]. Disponível em: http://www.fump.ufmg.br/conteudo.aspx?pagina=137

12. Costa V, Rosa MC. Medidas caseiras. Florianópolis: PET Nutrição, UFSC; 1997. [apostila]

13. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Coordenação Geral da Política de Alimentação e Nutrição. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília: Ministério da Saúde; 2006.

14. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation on obesity. Geneva: WHO; 2000.

15. Fundação Mendes Pimentel. Restaurantes universitários terão reajuste [Internet]. Belo Horizonte: Fump, UFMG; 2013. [acesso em: 13 maio 2014]. Disponível em: https://www.ufmg.br/online/arquivos/2005/01/restaurantes_universitrios_ter.shtml

16. Silva MR, Miranda MZ, Silva PRM, Xavier SC. Absorção de óleo de soja e sódio em arroz e feijão preparados. Pesq. Agrop. Trop. 2004; 34(1):21-27.

17. Oliveira RB, Guaglianoni DG, Demonte A. Perfil do usuário, composição e adequação nutricional do cardápio oferecido em um restaurante universitário. Alim. Nutr. 2005; 16(4):397-401.

18. World Health Organization. Diet, nutrition and the prevention of chronic diseases. Geneva: WHO; 2003.

19. Rodrigues AGM, Proença RPC, Calvo MCM, Fiates GMR. Perfil da escolha alimentar de arroz e feijão na alimentação fora de casa em restaurante de bufê por peso. Cienc. Saúde Colet. 2013; 18(2):335-346.

20. Fausto MA, Ansaloni JA, Silva ME, Garcia Júnior J, Dehn AA, Césa Tb. Determinação do perfil dos usuários e da composição química e nutricional da alimentação oferecida no restaurante universitário da Universidade Estadual paulista, Araraquara, Brasil. Rev. Nutr. 2001; 14(3):171-176.

21. Cabral HCC, Morais MP, Carvalho ACMS. Composição nutricional e custo de preparações de restaurantes por peso. Demetra: Alimentação, Nutrição e Saúde 2013; 8(1):23-38.

22. Bandoni DH, Canella DS, Levy RB, Jaime PC. Alimentação dentro ou for a do domicílio: análise da qualidade da refeição segundo o local de realização. Rev. Nutr. 2013; 2(6):625-632.

23. Bezerra IN, Souza AM, Pereira RA, Sichieri S. Consumo de alimentos fora do domicílio no Brasil. Rev. Saúde Pública 2013; 47(1Supl):200S-211S.

24. Araújo VMC, Borgo LAB, Montebello NP, Botelho RPB. Alquimia dos alimentos. Brasília: Senac; 2008. p. 209-213.

25. Machado M, Martins MAA, Andrade GQP, Kraemer FB. A qualidade nutricional e sensorial de preparações proteicas de unidades de alimentação e nutrição escolares: uma avaliação pelo método AQNS. Demetra: Alimentação, Nutrição e Saúde 2012; 7(3):145-156.

Received: July 15, 2015
Reviewed: September 18, 2015
Accepted: January 16, 2016