Food Chemistry **18** (1985) 163–168

Effect of Cooking on the Chemical Composition of Lentils, Rice and Their Blend (Koshary)

Laila A. E. Shekib, M. E. Zouil,
M. M. Youssef & M. S. Mohammed

Food Science and Technology Department,, Faculty of Agriculture,
University of Alexandria, Alexandria, Egypt

(Received: 21 March, 1985)

ABSTRACT

Lentils, rice and their blend (Koshary) were cooked by traditional Egyptian methods. Cooking resulted in slight changes in the total nitrogen, as well as in the non-protein nitrogen (NPN), ether extract and crude fibre of the three products, compared with raw grains. In contrast, significant decreases were found in the mineral elements, indicating losses through leaching, on washing and cooking. The mineral composition of lentils' cooking liquor confirmed this.

INTRODUCTION

Numerous papers have been published regarding the proximate chemical composition of lentils and rice. Nitrogen-free extract (NFE) of lentils was found to constitute 62·3 g/100 g of the edible portion (Kuzayli *et al.*, 1966). Different varieties of lentils showed no significant differences in terms of total carbohydrate contents (Janick & Hardlicka, 1969; Gafar, 1971). In contrast, considerable variation was found in the carbohydrate contents of rice varieties—a fact attributed to the effect of variety on protein content (Juliano *et al.*, 1964). This was, in turn, reflected in the carbohydrate content as a reverse correlation existed between starch and protein. El-Nahry *et al.* (1980) found that the crude fibre content ranged from 0·8 % to 1·5 %. Several authors have indicated that the crude fibre of

Food Chemistry 0308-8146/85/$03·30

white rice ranges between 0·16% and 1·2% (Fraser & Holmes, 1958; Kurasaura *et al.*, 1969; Chakrabarthy *et al.*, 1972).

Abu-Shakra & Tannous (1981) reported a 23·7% protein content in lentils while white rice was reported to contain 6·1% and 9·1% crude protein (Abdel-Naby, 1980; Kennedy, 1980; Abdel-Aal, 1983). The fat content of polished rice from Egyptian cultivars was found to vary from 0·33% to 0·95% (Abdel-Naby, 1980; Abdel-Aal, 1983).

According to Wassimi *et al.* (1977), lentil seeds are rich in iron and other minerals. Many environmental and genetic factors were implicated in determining the ash content of rice (Juliano *et al.*, 1964; Anderson, 1976; Juliano, 1980).

The present study was conducted on lentils, rice and their blend (Koshary) to explain the effects of cooking on their main chemical components. Such data are scarce, despite their significance in nutrition.

EXPERIMENTAL

Materials

Representative 20-kg samples of decorticated lentil seeds (variety Giza 9), grown in Esna, and rice grains (variety Giza 172), grown in El-Behaira governorate, were used in this work. Sorted and cleaned lentil seeds and rice grains were ground in an analytical mill (IKA-Werk-Jank and Kunked, West Germany) to pass through a 60 mesh screen.

Analytical methods

The moisture content of the flours was determined by drying at 105 °C to a constant weight (AOAC, 1980). Crude protein (NX 6·25 and NX 5·95) for lentils and rice, respectively (FAO/WHO, 1973) was determined by the semi-microKjeldahl method (Egan *et al.*, 1981). Non-protein nitrogen was estimated according to the procedure of Winston *et al.* (1968). Crude ether extract was determined by the Soxhlet method (AOAC, 1980). Ash was determined by igniting a weighed sample in a muffle furnace (Gallenkamp KM 1061 GKP 172) at 550 °C to a constant weight (AOAC, 1980).

The crude fibre content was determined according to the method

described by Egan *et al.* (1981). Total carbohydrate content was calculated by difference. For mineral determination, the ash was dissolved in 25 ml 3N HCl in a volumetric flask and filtered through Whatman ashless filter paper. The minerals determined using a Perkin-Elmer Atomic Absorption Spectrophotometer (Model 2380) were Ca, P, Fe, Na, K and Zn.

Cooking methods

The decorticated lentil seeds were washed with water, then cooked in boiling water (1:3 v/v seeds to water) for 30 min. They were then dried in a cabinet drier at 60 °C for 6 h, ground and stored in Kilner jars in a refrigerator until used. Rice was washed with water, then cooked in boiling water (1:1 v/v) until soft, then dried in a cabinet drier at 60 °C for 6 h and stored in airtight containers.

The mixture (Koshary) was formulated by mixing, by weight, two parts of rice and one part of lentils, washed and then cooked in boiling water (using an equal volume of water). The cooked Koshary was dried in a cabinet drier at 60 °C for 6 h, ground and stored in airtight containers in a refrigerator until used.

RESULTS AND DISCUSSION

Data presented in Table 1 reveal that slight changes occurred in the total nitrogen and non-protein nitrogen (NPN) on cooking lentils, rice and Koshary. The decreases in crude protein contents were 7·6%, 4·2% and 5·2% for lentils, rice and Koshary, respectively. Mixing rice with lentils in a 2:1 (w/w) ratio gave a blend containing a higher percentage of protein than rice but less than lentils.

Cooking caused a minor diminution of the ether extract, amounting to 3·3%, 5·5% and 0·6% for lentils, rice and Koshary, respectively.

Data given in Table 1 indicate that potassium constitutes the major mineral in the ash of lentils (753 mg/1000 g), while sodium and zinc are present in small amounts (5·11 and 4·61 mg/1000 g). Minerals suffered considerable loss upon cooking to reach only 37% of the original level in raw lentils. Data presented in Table 2 confirm this conclusion, since significant amounts of minerals were found in the cooking liquor, indicating that almost all minerals, especially potassium and phosphorus,

TABLE 1
Effect of Cooking on the Chemical Composition of Lentils, Rice and Their Blend (Koshary)
(Per cent on a dry weight basis)

Components	*Lentils*		*Rice*		*Koshary*	
	Raw	*Cooked*	*Raw*	*Cooked*	*Raw*	*Cooked*
Total nitrogen	4·88	4·52	1·68	1·49	2·85	2·72
Non-protein nitrogen	0·58	0·45	0·19	0·17	0·19	0·14
Crude protein[a]	26·9	24·9	8·25	7·86	16·1	15·6
Crude ether extract	1·23	0·86	0·54	0·48	1·1	1·04
Crude fiber	2·45	2·33	0·29	0·21	0·39	0·36
Ash	2·46	2·41	0·46	0·41	1·25	1·19
N-free extract[b]	67·0	69·5	89·3	91·8	81·7	82·2
Minerals (mg/1000 g)						
Calcium	42·00	15·40	41·00	28·5	44·1	16·3
Phosphorus	380	204	255	196	285	223
Iron	7·2	2·4	2·1	1·56	4·2	1·73
Sodium	4·61	3·8	12·0	7·96	8·65	4·9
Potassium	753	213	243	175	398	170
Zinc	5·11	3·13	5·12	3·1	5·35	3·15

[a] Conversion factors used were: 6·25, 5·95 and 6·05 for lentils, rice and Koshary, respectively.
[b] By difference.

TABLE 2
Chemical Composition of Lentils' Cooking Liquor

Components	*Moisture* (%)	*Crude protein*[a] (%)	*Total carbohydrates* (%)	*Ash* (%)	*Mineral content (mg/100 g) on a dry weight basis*					
					Ca	*P*	*Fe*	*Na*	*K*	*Zn*
Cooking liquor	96·94	1·40	1·62	0·04	10·2	133	3·04	2·71	406	0·92

[a] Conversion factor, 6·25.
[b] By difference.

suffered losses through leaching. In the case of rice grains, phosphorus and potassium were found to be the main minerals.

Considerable losses also occurred in the minerals of rice and Koshary as a result of cooking. In these cases, leaching out during washing was the cause. Only slight changes in the crude fibre content of the three products—lentils, rice and Koshary—occurred due to cooking.

REFERENCES

Abdel-Aal, E. M. (1983). *Chemical and technological studies on some legumes and rice as a source of protein.* MSc thesis, Faculty of Agriculture, Alexandria University, Egypt.

Abdel-Naby, A. (1980). *Studies on Egyptian rice.* MSc thesis, Faculty of Agriculture, Alexandria University, Egypt.

Abu-Shakra, S. & Tannous, I. J. (1981). Nutritional value and quality of lentils. In: *Lentils* (Webb, C. & Hawatin (Eds)). The International Center for Agricultural Research in the Dry Areas (ICARDA), 191–99.

Anderson, R. A. (1976). Wild rice: Nutritional review. *Cereal Chem.*, **53**, 949–55.

Association of Official Agricultural Chemists (AOAC) (1980). *Official methods of analysis.* AOAC, Washington, DC, USA.

Chakrabarthy, T. K., Dwarakanath, K. R. & Bhat, B. P. (1972). Studies on physico-chemical properties of some varieties of rice. *J. Food Technol.*, **2**, 140–3.

Egan, H., Kirk, S. R. & Sawyer, R. (1981). *Pearson's chemical analysis of foods.* Churchill Livingston, Edinburgh, London, Melbourne and New York, 15–19.

El-Nahry, F. I., Mourad, F. E., Khalik, S. M. & Bassily, N. S. (1980). Chemical composition and protein quality of lentils consumed in Egypt. *Qualitas Plantarum*, **30**, 87–95.

FAO/WHO Expert Committee on Energy and Protein Requirements (1973). Report, FAO Nutrition Meetings Report Series, No. 52; World Health Organization Technical Report Series No. 522.

Fraser, J. R. & Holmes, D. C. (1958). The proximate analysis of rice carbohydrates. *J. Sci. Food Agric.*, **9**, 511–15.

Gafar, A. M. (1971). *Studies on pre-cooked dehydrated soups.* MSc thesis, Faculty of Agriculture, Alexandria University, Egypt.

Janicek, G. & Hardlicka, J. (1969). Chemical composition of lens (Lentils). *Sbornik Vyske Skkoly Chemicko-Technol.*, Fraze, E. Potnaving 23, 55–61. (*cf.* C.A., 72, 89027).

Juliano, O. B. (1980). Properties of rice caryopsis. In: *Rice production and utilization* (Luh, B. S. (Ed.)). AVI Publishing Co. Inc., Westport, Connecticut, 403.

Juliano, O. B., Bautista, M. G., Lugay, C. J. & Reyes, C. A. (1964). Studies on the physicochemical properties of rice. *J. Agric. Food Chem.*, **12**, 131–4.

Kennedy, B. M. (1980). Nutritional quality of rice endosperm. In: *Rice production and utilization* (Luh, B. S. (Ed.)). AVI Publishing Co. Inc., Westport, Connecticut, 439–69.

Kurasaura, H., Kanauti, Y., Yamamato, I., Hayakawa, T. & Zgaue, I. (1969). Some physico-chemical properties of non-waxy paddy rice starch in Niigata Prefecture. Part I: Relation of properties of starch to eating and cooking quality of milled rice. *Agric. Biol. Chemistry*, **33**, 798–806.

Kuzayli, V. H., Cowan, W. J. & Sabry, Z. (1966). Nutritive value of Middle Eastern foodstuffs. II—Composition of pulses, seeds, nuts and cereal products of Lebanon. *J. Sci. Food Agric.*, **17**, 195–201.

Wassimi, N., Abu-Shakra, S., Tannous, R. & Hallab, A. (1977). Effect of mineral nutrition on cooking quality of lentils. *Can. J. Plant Sci.*, **58**, 165–9.

Winston, K. H., Steinkraus, D. B., Hand, D. B. & Wilkens, W. F. (1968). Soaking soybean before extraction as it affects chemical composition and yield of soy milk. *Food Technol.*, **22**, 138–45.