*Food Chemistry* **20** (1986) 39–44

# Chemical Composition of Egyptian Sweet Potatoes

Hattim M. Makki, A. Y. Abdel-Rahman, M. K. M. Khalil & M. S. Mohamed

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

(Received: 2 September, 1985)

*ABSTRACT*

*Two Egyptian sweet potato varieties were studied. The study showed considerable differences in chemical composition between the two varieties. The mineral found in the highest concentration was calcium, followed by magnesium, iron, copper, zinc and manganese.*

*The chemical composition of sweet potato protein isolates indicated that the pulp had high protein content. The maximum solubility of nitrogen was at pH 12 and 17 amino acids were separated from the protein isolate of both peel and pulp of the Giza 69 variety and from the pulp of the Abees variety. The protein isolate of the Abees variety had only 16 amino acids.*

## INTRODUCTION

Sweet potato is popular in Egypt where it is grown as a summer and autumn crop and consumed locally.

Sweet potatoes have long been recognized as available sources of carbohydrates and a good source of vitamins C and A, thiamine, riboflavin and niacin (Elkins, 1979). Isolated sweet potato protein was reported to possess a protein efficiency ratio (PER) equal to that of casein (Walter & Catignani, 1981).

This paper describes the chemical composition of two sweet potato varieties cultivated in Egypt.



*Food Chemistry* 0308-8146/86/$03·50 

## MATERIALS AND METHODS

Freshly harvested sweet potato tubers of the 'Abees' and 'Giza 69' varieties were obtained from the experimental farm of the College of Agriculture at Abees, Alexandria, Egypt.

The samples were washed, air-dried and peeled. The dry matter was determined as described by Purcell *et al.* (1978). Crude protein, crude fibre, crude fat, reducing and non-reducing sugars, ash and minerals were determined according to the methods of the AOAC (1980). A Perkin-Elmer Absorption Spectrophotometer (2380) was used for mineral analysis.

Protein isolates and nitrogen solubility at different pH values were determined according to the technique of Purcell *et al.* (1978) Amino acid determination was carried out with a Beckman 119, CL., Amino Acid Analyzer according to the method of Speckman *et al.* (1958). Tryptophan was determined by the method of Miller (1967).

Starch was calculated by substracting the total percentages of fat, protein, fibre, reducing and non-reducing sugars from 100.

## RESULTS AND DISCUSSION

### Chemical composition of sweet potatoes

Data in Table 1 show that considerable differences existed between the two varieties examined with respect to the dry matter content of both peel

**TABLE 1**
The Chemical Composition of Sweet Potatoes (on a dry weight basis)

| *Constituents* | *Variety Abees* | | *Variety Giza 69* | |
|---|---|---|---|---|
| | *Pulp* | *Peel* | *Peel* | *Pulp* |
| Ash | 4·8 | 15·2 | 13·0 | 4·4 |
| Crude protein | 5·0 | 6·7 | 7·4 | 4·9 |
| Crude fat | 1·0 | 1·8 | 1·9 | 1·1 |
| Crude fibre | 5·6 | 11·8 | 14·0 | 5·7 |
| Reducing sugars | 12·8 | 10·4 | 13·0 | 5·2 |
| Non-reducing sugars | 2·1 | 7·2 | 3·2 | 4·5 |
| Starch | 68·7 | 46·9 | 47·5 | 74·2 |

and pulp. Ash was higher in the peel of both varieties than in their corresponding pulps with small differences between the two varieties. There was more crude fat in peel than in pulp. Marked differences were found between the peel and pulp of the two varieties with regard to their contents of starch, crude fibre and nitrogen-free extract. The peel had lower percentages of nitrogen-free extract but contained higher percentages of crude fibre.

The differences in composition between the two varieties examined are attributed to varietal differences (Elkins, 1979; Goddard & Mathews, 1979).

## Mineral content of sweet potatoes

Table 2 shows that calcium was the most abundant mineral, followed by magnesium, iron, copper, zinc and manganese in the peel and the pulp of the two varieties, but the metals do not necessarily follow that order. Slight differences were observed in the peel and pulp of both varieties. These results do not differ from those reported by Elkins (1978) except for calcium in the pulp of both varieties—which is slightly lower in this study—but are in agreement with the results of Goddard & Mathews (1979).

## Solubility of sweet potato nitrogen as affected by pH

Table 3 shows that the extractability of nitrogen was higher at pH values above 9·0 and the maximum solubility was at pH 12·0. The weak

**TABLE 2**
Mineral Content of Sweet Potatoes (on a dry weight basis)

| *Mineral* | *Variety Abees* | | *Variety Giza 69* | |
|---|---|---|---|---|
| | *Pulp* | *Peel* | *Peel* | *Pulp* |
| | | (*mg/100 g*) | | |
| Ca | 6·73 | 42·3 | 75·0 | 6·94 |
| Mg | 3·94 | 6·28 | 4·87 | 3·12 |
| Fe | 0·56 | 4·38 | 3·68 | 0·26 |
| Cu | 0·47 | 0·25 | 0·29 | 0·18 |
| Zn | 0·33 | 0·65 | 0·55 | 0·27 |
| Mn | 0·08 | 0·23 | 0·36 | 0·18 |

**TABLE 3**
Solubility of Sweet Potato Nitrogen as Affected by pH

| *pH* | *Variety Abees* | | *Variety Giza 69* | |
|---|---|---|---|---|
| | *Pulp* | *Peel* | *Pulp* | *Peel* |
| | *(Soluble nitrogen per cent)* | | | |
| 1 | 74·0 | 45·0 | 75·5 | 51·0 |
| 2 | 62·0 | 31·5 | 68·5 | 46·2 |
| 3 | 35·5 | 20·0 | 39·4 | 22·0 |
| 4 | 28·5 | 19·4 | 33·5 | 21·2 |
| 5 | 29·0 | 30·5 | 32·5 | 34·5 |
| 6 | 35·8 | 51·5 | 39·5 | 60·1 |
| 7 | 55·9 | 63·3 | 57·0 | 65·0 |
| 8 | 71·2 | 67·0 | 76·5 | 69·5 |
| 9 | 80·0 | 67·5 | 82·0 | 71·2 |
| 10 | 86·0 | 70·8 | 87·1 | 72·1 |
| 11 | 88·0 | 71·5 | 90·0 | 73·0 |
| 12 | 92·0 | 72·0 | 94·0 | 73·4 |

extractability at low pH was attributed to the formation of insoluble peptide polyphenol complexes. Kilara *et al.* (1972) found similar results.

## Chemical composition of sweet potato protein isolates

Table 4 shows that the protein isolates of pulp had considerably higher protein contents than those of the peel, the difference being balanced by carbohydrates with the concentration in the peel isolates being 3 or 4-fold

**TABLE 4**
Chemical Composition of Sweet Potato Protein Isolates (on a dry weight basis)

| *Constituents* | *Variety Abees* | | *Variety Giza 69* | |
|---|---|---|---|---|
| | *Pulp* | *Peel* | *Peel* | *Pulp* |
| | (%) | | | |
| Crude protein | 76·5 | 33·5 | 53·3 | 80·9 |
| Crude fat | 4·3 | 3·0 | 2·9 | 5·9 |
| Total carbohydrates[a] | 11·5 | 47·5 | 32·6 | 8·6 |
| Ash | 7·6 | 15·7 | 11·0 | 4·4 |

[a] Calculated by difference.

**TABLE 5**
Amino Acids Analysis of Sweet Potato Protein

| *No.* | *Amino Acid* | *Variety Abees* | | *Variety Giza 69* | |
|---|---|---|---|---|---|
| | | *Peel* | *Pulp* | *Pulp* | *Peel* |
| | | (*g amino acid per 16 g N*) | | | |
| 1 | Aspartic acid | 12·4 | 10·4 | 10·5 | 13·6 |
| 2 | Serine | 5·5 | 4·7 | 5·6 | 5·6 |
| 3 | Glutamic acid | 12·4 | 11·9 | 12·8 | 12·0 |
| 4 | Proline | 3·3 | 4·4 | 4·5 | 1·5 |
| 5 | Glycine | 5·5 | 5·5 | 3·8 | 4·0 |
| 6 | Alanine | 6·3 | 5·3 | 5·9 | 6·3 |
| 7 | Histidine | 2·3 | 2·8 | 2·4 | 1·9 |
| 8 | Arginine | 4·5 | 4·4 | 4·8 | 5·8 |
| | Total non-essential | 52·2 | 49·4 | 50·3 | 50·7 |
| 9 | Threonine | 4·7 | 4·8 | 3·4 | 5·4 |
| 10 | Valine | 6·3 | 5·3 | 7·9 | 7·2 |
| 11 | Methionine | Absent | 1·4 | 1·2 | 0·7 |
| 12 | Cystine | Absent | Absent | Absent | Absent |
| 13 | Isoleucine | 6·1 | 6·2 | 5·2 | 5·8 |
| 14 | Leucine | 12·7 | 12·1 | 11·8 | 10·2 |
| 15 | Tyrosine | 2·5 | 3·0 | 3·4 | 3·2 |
| 16 | Phenylalanine | 4·2 | 4·9 | 4·9 | 5·5 |
| 17 | Lysine | 6·3 | 7·8 | 7·1 | 6·3 |
| 18 | Tryptophan | 1·7 | 3·5 | 3·3 | 2·7 |
| | Total essential | 44·5 | 49·0 | 48·2 | 47·0 |

that in the pulp isolates. Purcell *et al.* (1972) found that the total protein in sweet potato protein isolates was 79·6%.

Ash content in the peel protein isolates was more than twice as great as that in the pulp.

**Amino acids content of sweet potato protein isolates**

Data in Table 5 indicate slight differences in the amino acids patterns of the protein isolates of the two sweet potato varieties in both peel and pulp. Seventeen amino acids were separated and estimated in the acid hydrolyzate of the sweet potato protein isolates from both peel and pulp of the Giza 69 variety and from the pulp of the Abees variety. The peel isolate of the matter had only sixteen amino acids.

Methionine was absent in Abees peel protein isolate. Cystine was completely absent from all isolates. The pulp protein isolates of both varieties were quite similar in their content of phenylalanine and had the highest values in lysine and tryptophan compared with those in peel isolates of both varieties.

The results obtained in this study are in good agreement with those reported by Purcell *et al.* (1972; 1978).

## REFERENCES

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

Elkins, E. R. (1979). Nutrition content of raw and canned green beans, peaches and sweetpotatoes. *Food Techn.*, **33**, 66–70.

Goddard, M. S. & Mathews, R. H. (1979). Current knowledge of nutritive values of vegetables. *Food Tech.*, **33**. 71–74.

Kilara, A., Humberg, E. S. & Sousulski, F. W. (1972). Nitrogen extractability and moisture adsorption characteristics of sunflower seed products. *J. Food Sci.*, **37**, 771–774.

Miller, E. H. (1967). Determination of the tryptophan content of foodstuffs with particular reference to cereals. *J. Sci., Fd, Agric.*, **18**, 381–384.

Purcell, A. E., Swaisgood, H. E. & Pope, D. T. (1972). Protein and amino acid content of sweetpotato cultivars. *J. Am. Soc. Hort. Sci.*, **97**, 30–33.

Purcell, A. E., Walter, W. M. Jr. & Giesbrech, F. G. (1978). Protein and amino acids of sweetpotato fractions. *J. Agric. Food Chem.*, **26**, 699–701.

Speckman, D. H., Stein, W. H. & Mooer, S. (1958). Automatic recording apparatus for use in the chromatography of amino acids. *Anal. Chem.*, **30**, 1190–95.

Walter, W. M. Jr. & Catignani, G. L. (1981). Biological quality and composition of sweetpotato protein fractions. *J. Agric. Food Chem.*, **29**, 797–8.