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Effect of Drying Methods on Chemical Composition of Spinach "Aieifo" (*Amaranthus aquatica*) and Pumpkin Leaf (*Telfairia occidentalis*) and Their Soup Meals

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Abstract: The study evaluated the effect of drying; methods on chemical composition of spinach, "aleifo" (*Amaranthus aquatica*) and pumpkin leaf (*Telfairia occidentalis*) and their soup meals. The two vegetables were purchased from local market in Unale-Ibaji Local Government Area, Kogi State, Nigeria in bulk. These two vegetables were washed, cleaned, plucked from the stalk and processed to mimic traditional methods of preserving vegetables. The vegetables were divided into three equal portions. The first portion served as the control, the second and third portions were sun and shade dried. Aliquots of the dried samples were pulverized, sieved, packaged in polythene bags and kept in cool dry place until used for various chemical analysis. The other dried portions as well as their controls (fresh) were used for preparation of soup meals. The chemical composition of the vegetables and their soup meals were determined using current standard methods. Sun and shade drying drastically reduced moisture content of the vegetables when compared to the controls (84.47-7.80 and 7.42%). The protein for the sun and the shade dried samples were higher than those of the controls (3.50 and 4.70 vs 6.47, 5.50 and 5.77 and 5.44%, respectively) ($p<0.05$). Ash, fat and fibre content of the dried samples were also higher. Carbohydrate values for the two vegetables were slightly high and comparable (47.36 and 48.40%) than those of the controls. Calcium, iron and zinc of the fresh samples were higher than those of the dried samples. Drying comparably increased energy from 131.37-198 and 197 kcal, each. Drying increased iodine and decreased β-carotene and ascorbate as against the controls. Drying equally decreased phytate and tannins relative to their controls. The moisture values for soup prepared with dried vegetables were lower than those prepared with fresh vegetables. The dry matter (protein, fat, ash and carbohydrate) for the soups prepared with dried vegetables were much higher than those prepared with fresh vegetables. On the other hand, calcium, iron, zinc and iodine values for soups prepared with fresh vegetables were higher than those prepared with fresh vegetables were higher than those prepared with dried vegetables. Phytate and tannins values for soups based on dried vegetables were lower than those based on fresh vegetables. Fresh vegetables had higher iron, vitamin A and ascorbate than the dried vegetables. Shade drying had an edge in increasing iron, iodine, zinc, pro-vitamin A and ascorbate over sun drying. However, sun drying lowered phytate and tannins more than shade drying. Shade drying is a better drying method to preserve and retain nutrient in these two green leafy vegetables.

Key words: Sun and shade drying, chemical content, green leafy vegetables

INTRODUCTION

In the past, consumption of green leafy vegetables was attributed to sign of poverty. It was assumed that, people that consume them were too poor to afford meat. Green leafy vegetable production has less competitive advantage among other agricultural products. The green leafy vegetable production appears to be less attractive to farmers. It has been confirmed that the production, practices, processing and marketing of vegetable, especially the commonly consumed ones such as *Telfairia occidentalis* have received negligible attention. Green leafy vegetables are rich sources of micronutrients (Ogbona, 1991). Poor nutrition education has precipitated the unpopularity of green leafy vegetables in some traditional diets consumed in Nigeria (Udofia and Obizoba, 2005). Green leafy vegetables constitute an essential constituent of the diets in most parts of Nigeria. Some green leafy vegetables could be consumed raw, however, others are consumed as cooked complements to the major staples such as cassava, millet, maize and rice. Most meals are considered incomplete without generous serving of cooked green leafy vegetables in Kogi State. Seasonality remains a major constraint to utilization of green leafy vegetables in the dry season. This is because there is no irrigation system available for the production all year round. Seasonal variations affect production, availability and quantities consumed by the masses. This is because they are scarce and expensive.

In Kogi State, iron, iodine and vitamin A deficiency diseases are among the cases of malnutrition. Dried vegetables could be the solution to seasonality of vegetables consumption and possibly elimination of these micronutrient deficiencies. No comparative studies on nutritional value of dried and fresh vegetables in Kogi State. The thrust of this study was to determine the effect of drying methods on chemical composition of spinach (*Amaranthus aquatica* and *Telfairia occidentalis*) commonly consumed in Ibaji rural community of Kogi State.

MATERIALS AND METHODS

Spinach, "aleifo" (*Amaranthus aquatica* and *Telfairal occidentalis*) were purchased from Unale-Ibaji, Kogi State of Nigeria in bulk. These two vegetables were washed with clean water and each divided into three portions. The fresh portions served as the controls. The remaining two portions of each vegetable were sun and shade dried for seven and ten days, respectively to 98% dry matter. Each of the dried vegetable was divided into portions. One portion of each was pulverized, sieved through (65 mesh screen), packaged in polythene bags and stored in cool dry place until used for various chemical analyses. The unpulverized portions were used for preparation of soup meals. Both the dried and the fresh vegetables and the soups were chemically analyzed for nutrients and anti-nutrients using standard techniques (AOAC, 2000). The data generated was statistically analyzed using means, standard deviation, and standard error of the means. Duncan's Studentized New Multiple Range Test was selected to separate and compare means (Steel and Torrie, 1960).

RESULTS

Table 1 presents the proximate composition of *Amaranthus aquatica* and *Telfairia occidentalis* (%). The moisture content of the fresh samples of the two vegetables was high and comparable (84.47 and 84.17%) for fresh *Amaranthus aquatica* (FAA) and *Telfairia occidentalis* (FTO). The sun and the shade dried *Amaranthus aquatica* samples had much lower values when compared with the control (84.47 vs 7.8 and 7.42%). The much lower moisture for dried samples of *Telfairia occidentalis* appeared to be a trend as that of *Amaranthus aquatica* as the control (84.17 vs 6.88 and 7.13%).

The protein for the two vegetables differed. The range for that of *Amaranthus aquatica* was from 3.50-6.47% and that of *Telfairia occidentalis* was from 4.70-5.77%. The two drying methods increased protein of these vegetables relative to their controls. In both vegetables, sun drying had an edge over shade drying in increasing protein (6.47 vs 5.77%). On the other hand, shade drying increased protein of comparable value in the two vegetables (5.50 and 5.44%) for *Amaranthus aquatica* and *Telfairia occidentalis*. The ash values for the two vegetables were influenced by the drying methods. In *Amaranthus aquatica*, the value increased from 2.17 to 17.70% and in *Telfairia occidentalis*, it was from 1.92 to 18.30%. The fresh sample of *Telfairia occidentalis* was lower than that of *Amaranthus aquatica* (1.92 vs 2.17%, each). On the other hand, the dried *Amaranthus aquatica* had lower ash than those of *T. occidentalis* (17.00 and 17.70 vs 18.30 and 18.20%). In *T. occidentalis*, both drying methods caused equal increases in ash (18.30 and 18.20%).

The fresh samples of both vegetables had comparable fat (0.24%). Sun and shade drying caused increases in both vegetables. The increases in fat were slightly higher in *T. occidentalis* than in *A. aquatica* (2.07 and 2.30 vs 2.00 and 2.20%). When the values were summed up and compared (2.37 and 2.20%) the difference was only 0.17% (2.37-2.20%). The fibre content of the two fresh vegetables was low and comparable (2.01 and 2.06%, respectively) relative to the dried samples. The fibre for the dried *Amaranthus aquatica* (SDAA and SHAA) was higher than those of *T. occidentalis* (SDTO and SHTO) (19.70 and 19.39 vs 18.81 and 19.44%, respectively). When the two fibre values were summed up and compared, the *Amaranthus aquatica* had 39.09 and *T. occidentalis* had 38.25%. The difference was only 0.84% (39.09-38.25%). The Carbohydrate (CHO) values for the two fresh vegetables were low (7.65 and 6.75%) for FAA and FTO, respectively. The dried samples for both vegetables were less than 50.00%. The two dried *A. aquatica* (SDAA and SHAA) had 47.36 and 48.12% and those of *T. occidentalis* were 48.40 and 47.81%, each. The energy values for the two fresh vegetables were low (31.37 and 27.68 kcal, each). The drying methods increased energy in both samples. The drying methods increased energy

Table 1: Chemical composition of fresh, sun and shade dried *Amaranthus aquatica* and *Telfaira occidentalis* (%)

Samples	Moisture	Protein	Ash	Fat	Fibre	CHO	CV (kcal/g)
FAA	84.47±0.04	3.50±0.25	2.17±0.06	0.24±0.03	2.01±0.07	7.65±0.06	31.37
SDAA	7.80±0.05	6.47±0.06	17.00±0.05	2.00±1.00	19.70±0.05	47.36±0.06	194.18
SHAA	7.42±0.07	5.50±0.06	17.70±0.04	2.20±0.05	19.39±0.05	48.12±0.08	197.29
FTO	84.17±0.07	4.70±0.03	1.92±0.05	0.24±0.05	2.06±0.04	6.75±0.04	27.68
SDTO	6.88±0.30	5.77±0.01	18.30±0.05	2.07±0.05	18.81±0.03	48.40±0.03	198.44
SHTO	7.13±0.08	5.44±0.06	18.20±0.05	2.30±0.05	19.44±0.05	47.81±0.04	196.02

Mean±SD of three determinations. FAA = Fresh *Amaranthus aquatica*; SDAA = Sun Dried *Amaranthus aquatica*; SHAA = Shade Dried *Amaranthus aquatica*; FTO = Fresh *Telfairia occidentalis*; SDTO = Sun Dried *Telfairia occidentalis*; SHTO = Shade Dried *Telfairia occidentalis*; CV = Caloric Value (kcal/g)

Table 2: Micronutrient content of fresh, sun and shade dried *Amaranthus aquatica* and *Telfairia occidentalis* (mg/100 g)

Samples	Ca	Fe	Zn	Io	β-carotene	Ascorbic acid
FAA	0.67±0.03	0.16±0.04	0.00±0.00	3.59±0.01	64.2±0.32	69±32
SDAA	0.12±0.05	0.09±0.03	0.00±0.00	18.82±0.00	53.4±0.32	1.6±0.32
SHAA	0.09±0.04	0.09±0.05	0.07±0.05	18.40±0.27	129.0±0.32	1.6±0.32
FTO	3.25±0.04	0.15±0.05	0.06±0.05	5.90±0.32	479.1±0.32	345±32
SDTO	0.07±0.04	0.06±0.04	0.05±0.04	22.70±0.46	192.9±0.32	2.2±0.00
SHTO	0.09±0.04	0.08±0.04	0.06±0.05	20.06±0.10	79.5±0.32	2.2±0.32

Mean±SD of three determinations. FAA = Fresh *Amaranthus aquatica*; SDAA = Sun dried *Amaranthus aquatica*; SHAA = Shade Dried *Amaranthus aquatica*; FTO = Fresh *Telfairia occidentalis*; SDTO = Sun Dried *Telfairia occidentalis*; SHTO = Shade Dried *Telfairia occidentalis*

Table 3: Proximate content of soup meals based on fresh and dried *Amaranthus aquatica* and *Telfairia occidentalis* (%)

Samples	Moisture	Protein	Ash	Fat	Fibre	CHO	CV (kcal)
FAAS	10.47±0.06	15.59±0.03	11.69±0.04	9.39±0.00	9.92±0.03	43.24±0.06	177.28
SDAAS	10.28±0.05	15.92±0.04	11.32±0.05	8.40±0.05	10.98±0.03	43.37±0.05	177.82
SHAAS	9.50±0.04	14.49±0.05	11.99±0.04	7.59±0.05	10.84±0.15	44.96±0.03	184.34
FTOS	9.92±0.04	15.60±0.05	10.79±0.04	7.53±0.00	11.19±0.61	45.69±0.27	187.33
SDTOS	9.91±0.03	15.15±0.08	10.60±0.03	8.89±0.05	10.30±0.06	45.46±0.04	186.39
SHTOS	10.17±0.06	15.38±0.05	10.02±0.08	7.57±0.02	10.27±0.05	46.24±0.10	189.58

Mean±SD of three determinations. FAA = Fresh *Amaranthus aquatica*; SDAA = Sun Dried *Amaranthus aquatica*; SHAA = Shade Dried *Amaranthus aquatica*; FTO = Fresh *Telfairia occidentalis*; SDTO = Sun Dried *Telfairia occidentalis*; SHTO = Shade Dried *Telfairia occidentalis*; CV = Caloric Value (kcal)

more in *T. occidentalis* than in *A. aquatica* when summed up and compared (394.46 and 391.47 kcal) (Table 1).

Table 2 presents the micronutrient content of fresh, sun and shade dried *Amaranthus aquatica* and *Telfairia occidentalis*. The fresh samples of the two vegetables had low calcium. *A. aquatica* had 0.67 mg and *T. occidentalis* had 1.25 mg which was higher (1.25 vs 0.67 mg). The drying methods reduced calcium in both vegetables. The reduction was much more in *T. occidentalis* (1.25 to 0.07 and 0.09 mg) (SDTO and SHTO). On the other hand, the reduction was much lower in the *A. aquatica* relative to the fresh samples (0.67 vs 0.12 and 0.09 mg). The iron content of the two fresh samples (FAA and FTO) was 0.16 and 0.15 mg, each. The drying methods caused comparable reduction in iron in both vegetables. In *A. aquatica*, the reduction was from 0.16-0.09 mg and in *T. occidentalis* it was from 0.15-0.06 and 0.08 mg, respectively.

Zinc content of the vegetables varied. The fresh and the sun dried *A. aquatica* samples had no zinc (0.00 mg). However, the shade dried samples had very low value (0.09). Zinc content of *T. occidentalis* was very small and comparable regardless of drying methods. It ranged from 0.05-0.06 mg. Surprisingly, the two fresh vegetables (FAA and FTO) had very low iodine concentration. When compared to the dried samples (SDAA, SHAA and SDTO and SHTO) (3.59 and 5.90 vs 18.82, 1840 and 22.70 and 20.06 mg, respectively). Sun drying increased iodine more in both vegetables than shade drying. The increases however, were much more for *T. occidentalis* (SDTO and SHTO) (22.70 vs 20.06 mg) and for *A. aquatica*, the values were 18.82 and 18.40 mg, each.

The provitamin A (β-carotene) values were high for the two fresh samples (FAA and FTO) (21.30 and 59.60 vs 17.70, 18.90 and 24.20 and 26.40 mg). The decrease was much more for *T. occidentalis* (59.60 to 24.20 and 26.40 mg). The decrease for *A. aquatica* was from 21.30 to 17.70 and 18.90 mg. Shade drying caused the least decrease in β-carotene in the two vegetables (SHAA and SHTO) (18.90 and 26.40 vs 21.30 and 59.60 mg).

The ascorbate for the two fresh samples were higher than the dried samples (FAA, FTO vs SDAA, SHAA and SDTO and SHTO) (69.00 and 45.00 vs 1.6, 1.6, 2.20 mg, respectively). Both methods reduced ascorbate much more drastic in *Amaranthus aquatica*.

Table 3 presents proximate content of soup meals based on fresh and dried *Amaranthus aquatica* and *Telfairia occidentalis*. Moisture content of soups based on the two fresh vegetables differed (FAA and FTOS) (10.46 and 9.92% respectively). The soups based on sun dried vegetables (SDAAS and SDTOS) were lower than those based on fresh vegetables (10.28 vs 10.46 and 9.91 vs 9.92%, each). The moisture value for the soup based on shade dried, *A. aquatica* (SHAAS) was lower than those based on fresh and sun dried samples (FAA and SDAA) (9.50 vs 10.46 and 10.28%, each). On the other hand, the soup based on shade dried *T. occidentalis* (SHTOS) had higher moisture than both soups based on the fresh and the sun dried vegetables (10.47 vs 9.92 and 9.91%).

The protein values for the two soups varied. The protein for the two soups based on fresh vegetables (FAA and FTOS) was high and comparable (15.59 and 15.60%). On the other hand, the soup based on sun dried *A. aquatica* (SDAAS) had higher protein than that of sun dried *T. occidentalis* (SDTOS) based soup (15.92 vs

15.60%). The soup based on shade dried *A. aquatica* (SHAA) was lower than that of *T. occidentalis* (SHTOS), (14.9 vs 15.38%). The effect of drying methods on as of both soup vegetables differed. Shade drying slightly increased ash in soup on *A. aquatica* (SHAAS) as against the control (11.99 vs 11.69%) on the other hand, shade drying decreased ash in soup base on *T. occidentalis* (SHTOS) relative to the control (10.02 vs 10.79%). However, sun drying caused decrease in ash value of the two soup vegetables relative to their controls (11.32 vs 11.69 and 10.79 vs 10.60%). The differences in ash for both soup vegetables were 0.37 and 0.19% for *A. aquatica* and *T. occidentalis*, respectively.

The fat value for soup based on fresh *A. aquatica* (FAAS) was high (9.39%). The fat content of soups based on dried vegetables (SDAAS and SHAAS) were lower relative to the control (FAAS) (8.40 and 7.59 vs 9.39 each). Shade drying decreased fat in soup based on dried *A. aquatica* vegetable. The decrease was from 9.39-7.59%. It increase fat in *T. occidentalis* from 7.53-7.57%, the increase was very insignificant (0.04%). Sun drying also increase fat in *T. occidentalis* based soup from 7.53-8.89%. Drying methods had varied effects on fibre content of the two soups. The soup based on fresh *A. aquatica* had 9.92% fibre. Sun and shade drying increased fibre content of soups based on dried *A. aquatica* vegetable (SDAAS and SHAAS) relative to the control (FAAS) (9.92 vs 10.98 and 10.84%, each). On the other hand, both treatments lowered fibre from 11.19-10.30 and 10.27% in *T. occidentalis* based soups.

The CHO content of the soups based on fresh and dried *A. aquatica* and *T. occidentalis* had comparable values. The values for CHO of the soups were 43.24, 43.37 and 44.96% for *A. aquatica* and 45.69, 45.46 and 46.24% for *T. occidentalis* soups (Table 3). The soups that contained shade dried *A. aquatica* and *T. occidentalis* vegetables had higher CHO than both the soups that contained fresh and the sun dried vegetables (44.96 and 46.24%, each). The energy values for the soups differed. It ranged from 177.28-184.34 kcal for *A. aquatica* soups and from 186.39-189.58 kcal for *T. occidentalis* soups (Table 3). Again, the soups based on shade dried *A. aquatica* and *T. occidentalis* vegetables had an edge over those soups based on fresh and sun dried vegetables (184.34 and 189.58 vs 177.82 as well as 187.33 and 186.39 kcal, respectively).

DISCUSSION

The high moisture content (84.47 and 84.17%) for both fresh *A. aquatica* and *T. occidentalis* vegetables was not a surprise; fresh foods, especially vegetables contain high moisture. The present observation agreed with those of many (Udofia and Obizoba, 2005). The lower moisture for the sun and the shade dried vegetables was expected. Drying is known to reduce moisture to improve the shelf life of foods and increase dry matter. Wachap (2005) reported similar observation in many dried vegetables consumed in Taraba State, Nigeria.

The increase in protein for the two vegetables was due to loss of moisture during drying processing. Many workers had reported similar phenomenon. It is known that loss of moisture increase nutrient content and extends keeping quality of the food (Osagie and Onigbide, 1992). The higher ash (17.00, 17.70, 18.30 and 18.20%) for the sun and the shade dried *A. aquatica* and *T. occidentalis* vegetables as against their controls was attributed to loss of moisture that led to increase dry matter. Ash is among those dry matters. These increased were similar to that of Umoh (2003). The low ash for the fresh vegetables strongly suggested that these fresh vegetables are not good sources of ash.

The low fat values for *A. aquatica* (0.24-2.20%) and 0.24-2.30% for *T. occidentalis* (Table 1) was expected. Vegetables are known to contain very small amount of fat to maintain cell wall integrity. The slightly higher fat for the shade dried samples (2.20 and 2.30%) for SHAA and SHTO relative to their controls and sun dried samples appeared to indicate that shade drying had an advantage over sun drying to increase fat in the vegetables. The lower fat (2.00 and 2.07%) for sun dried samples showed that these vegetables would keep longer than their counter parts (fresh and shade dried samples because the higher the fat content of food, the lower is its keeping quality. The higher fibre for the dried samples of both vegetables were due to loss of moisture and vegetables goods sources of fibre. In addition, it is known that loss of moisture increases nutrient density in foods of which fibre is among the nutrients. The lower CHO for the two vegetables, especially the fresh one's are poor sources of CHO. However, the less than 50% increases observed in the present study was due to loss of moisture that precipitate increased nutrient density of which CHO is one of them (Table 1). The lower caloric values for fresh vegetables (FAA and FTO) is expected. This is because green leafy vegetables are poor sources of energy. The higher energy (194.18, 197.29 and 198.44 and 196.02 kcal) for the dried samples SDAA, SHAA and SDTO and SHTO) was due to loss of moisture that increased all the sources of energy (protein, fat and carbohydrate) which in turn caused increases in energy - a commonly observed phenomenon.

The slightly higher calcium (0.67 and 1.25 mg) for the two fresh vegetables showed that they are poor sources of calcium. The lower values for the dried samples indicated that none of the drying methods was beneficial to increase calcium in these vegetables (Table 2). It appeared to be higher concentration of iron in both fresh vegetables relative to dried samples (0.16 vs 0.09 and 0.15 vs 0.06 and 0.08 mg, respectively) for (FAA, SDAA, SHAA and FTO, SDTO and SHTO samples). The traces of zinc (0.00 mg) for the fresh and the sun dried *A.*

aquatica, showed that the vegetable was a poor source of the nutrient. It also showed that none of the drying methods could improve the levels of zinc in this vegetable. On the other hand, the low and comparable zinc for the fresh and dried *T. occidentalis* showed that its zinc nutritive value could not be improved by sun and shade drying.

The lower iodine (3.59 and 5.90 mg) for fresh *A. aquatica* and *T. occidentalis* relative to the sun and the shade dried samples (18.82, 18.40 and 22.70, 20.06 mg) meant that iodine is low in the fresh samples. On the other hand, the higher iodine for fresh and dried samples of *T. occidentalis* than those of *A. aquatica* (5.90, 22.70, 20.06 and 3.59, 18.82 and 18.40 mg, each) clearly showed that *T. occidentalis* was a better source of iodine than *A. aquatica*. The higher iodine for sun dried samples of the two vegetables showed that sun drying had an advantage over shade drying in improving iodine in the two vegetables (18.82 and 22.70 mg, each) (Table 2).

The higher β-carotene (21.30 and 59.60 mg) for fresh *A. aquatica* and *T. occidentalis* demonstrated that the nutrient (vitamin A) was much more concentrated in fresh samples than in dried samples. The lower β-carotene for dried samples of both vegetables was not a surprise. β-carotene and related derivatives are known to be volatile when exposed to mild heat. Based on this, sun or shade or both drying might have led to the loss of β-carotene during drying processes. Udofia and Obizoba (2005) and Wachap (2005) had experienced the same phenomenon in various fresh green leafy vegetables they investigated.

The lower ascorbate for dried samples of the two vegetables relative to their fresh controls was solely attributable to treatments. Ascorbate is water soluble and volatile when heat treated. It might be that the heat generated during sun and shade drying caused its loss. The loss was much more in *A. aquatica* which meant that ascorbate was much more volatile in *A. aquatic* than in *T. occidentalis* (Table 2).

The comparable moisture (10.46 and 10.28 and 9.92 and 9.91%) for soups based on fresh and sun dried samples of the two vegetables showed that sun drying was not beneficial. On the other hand, the lower moisture (9.50%) for soup based on shade dried *A. aquatica* than that of *T. occidentalis* (10.17%) meant that the soup would keep longer than its counterpart (Table 3). The lower protein (14.49%) for soup based on shade dried *A. aquatica* (SHAA vegetable meant that shade drying was not beneficial relative to its control (FAAS) (15.59%). The similarity in protein of soups based on both fresh and sun dried *A. aquatica* and *T. occidentalis* vegetables (SDAAS, FAAS and SDTOS and SHTOS) (15.59, 15.92 and 15.60 and 15.15%) meant that sun drying had no beneficial effect on protein of the two vegetables. The comparable ash (11.69, 11.32 and 11.99%) for *A. aquatica* and (10.79, 10.60 and 10.02%) for *T. occidentalis* meant that the two drying methods had no advantage over their controls (Table 3). It clearly showed that any could substitute the other as source of ash (mineral). The lower fat for the soups based on sun and shade dried *A. aquatica* vegetables have some nutrition implications. The diabetics and the obese patients would much more prefer them to the control that had higher fat (SDAAS and SHAAS) (8.40 and 7.59%). The increase in fat content (8.89 and 7.57 vs 7.53%) of the soups based on sun and shade dried *T. occidentalis* might be associated with the oil used for the soup preparation - a commonly observed fact.

The comparable fibre (10.98, 10.84 and 10.30 and 10.27%) for the soups based on sun and shade dried *A. aquatica* and *T. occidentalis* vegetables meant that any of the drying methods could be applied to increase fibre in the soups (Table 2). The similarity in CHO (43.24 to 44.96 and 45.46 to 46.24%) for FAAS, SDAAS, SHAAS and FTOS, SDTOS and SHTOS, based soups meant that the soups regardless of the forms of the vegetables used for their preparation had equal capability to furnish CHO. This observation is equally true of energy values of the soups (Table 3).

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