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Proximate Composition of Five Varieties of Spontaneous Leafy Vegetables Regularly Consumed In Côte D'Ivoire Areas

Stéphane-Joël Ehouan Ehilé[1,2*], Nestor Kouakou Kouassi[1], Denis Yao N'Dri[1], Adam Kouamé Camille[1] and Georges N'Guessan Amani[1]

[1]Laboratory of Food Biochemistry and Tropical Products Technology, Department of Food Science and Technology, NanguiAbrogoua University, 02 BP 801 Abidjan 02, Côte d'Ivoire
[2]Department of Pharmacy, University Hospital Center of Cocody, Abidjan, Côte d'Ivoire
**Corresponding author*

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A B S T R A C T

The aim of the study was to investigate on nutrient composition of *Vernonia amygdalina* (*Abôvi*), *Talinum triangulare* (*Anangobrou*), *Ximenia americana* (*Kogolémrou*), *Piper guineense* (*Fèfèbrou*) and *Ceibapentandra* (*Nanmougou*), five varieties of spontaneous leafy vegetables regularly consumed in Côte d'Ivoire. The fresh samples were analyzed for selected proximate constituents, nutrients and antinutrients. Results of proximate analysis showed dry matter (88.017 - 93.970 %), ash (6.001 - 22.001 %) and crude fiber (15.082 - 25.061 %). *Kogolémrou* had the highest protein (28.001 %). Substantial micronutrients amounts were obtained for *Fèfèbrou* with 0.309 mg/100 g (β-carotene) and 0.4450 mg/ 100 g (iron). *Abôvi* had the high test content of vitamin B9 (11041 mg/100 g) and *Anangobrou* was richest in potassium (7372 mg/100 g), calcium (1629 mg/100 g) and magnesium (1780 mg/100 g). The sodium / potassium ratio was under 1 for all species. Appreciable level of polyphenols (10.17 - 16.73 mg/100 g) was recorded. In view of this, studied leafy vegetables constitute good sources of nutrients and could contribute to prevent diseases and remedy rural population diets deficiency.

Introduction

Non-timber forest products or vegetable plants are all organs of wild animal or plant species harvested in various ecosystems (Augustino *et al.*, 2011). According to FAO (1988), vegetable plants are all plants whose leaves, fruits and roots are used in the preparation of sauces. For this purpose, spontaneous leafy vegetables play an important role in the diets of all the populations of the world, particularly in Africa. Many of them are resilient, adaptive, and tolerate adverse climatic conditions more than the exotic species (Raghuvanshi, 2001).

Spontaneous leafy vegetables represent high quality nutritional sources, for the poor segment of the population especially where malnutrition is wide spread (Nnamani *et al.*, 2009). They are valuable sources of nutrients especially in these areas where they contributes substantially to protein, minerals, vitamins, fibers and other nutrients which are usually in short supply in daily diets (Mohammed and Sharif, 2011). Moreover, a real interest for consumers is emerged since epidemiological studies have linked the dietary habits and the prevalence of certain

diseases such as cancers, obesity and cardiovascular diseases (Li *et al.,* 2014; Wang *et al.,* 2016).

It is reported that an estimated amount of 6376 useful spontaneous African plants of which 397 are vegetables, about twenty (20) species are widely consumed and cultivated by Ivorian populations (PROTA, 2004; Fondio *et al.,* 2007). The consumption of these leafy vegetables is linked to the region and ethno-botanical studies have stated that most people in Northern Côte d'Ivoire consume indigenous green leafy vegetables (Fondio*et al.,* 2007; Soro *et al.,* 2012).

Furthermore, many writers were mentioned the nutrient potential of certain leafy vegetable (Acho *et al.,* 2014; Oulai *et al.,* 2014 and 2015). However, there is data gap to offset regarded the large majority and wide diversity of spontaneous leafy vegetable available in Côte d'Ivoire. *Vernonia amygdalina (Abovi), Talinum triangulare (Anangobrou), Ximenia americana (Kogolémrou), Piper guineense (Fèfèbrou) and Ceiba pentandra (Nanmougou)* are regularly consumed in rural and urban areas of Côte d'Ivoire. In spite of the long term use of the vegetables leaves in various traditional dishes preparations, there is scarcity of information on their nutritive value. This study therefore targeted to assess proximate composition of these spontaneous leafy vegetables.

Materials and Methods

The five spontaneous leafy vegetables were collected fresh and at maturity from the local farmers in the Gagnoa district of West-Central Côte d'Ivoire. The fresh leaves were air dried in the laboratory. Thereafter, they were oven-dried, milled into powder and stored in polyethylene bags at room temperature prior to analysis.

Proximate composition of the spontaneous leafy vegetables was determined using Official Method of Analysis (AOAC, 1990) procedures for the determination of dry matter, ash, crude fibre, crude lipid, crude protein and minerals.The determination of carotenoids (Pro-vitamin A) and water-soluble vitamin (folic acid) were carried out by high-performance liquid chromatography (HPLC) analysis respectively according to Miglio *et al.,* (2008) and Hasan *et al.,* (2013). The phenolic compounds were extracted following the procedure described by N'Dri *et al.,* (2013), and determined by the Folin-Ciocalteu assay (Singelton *et al.,* 1999). The oxalate and phytate content were determined respectively using method described by Day and Underwood (1986) and Mohammed *et al.,* (1986).

Duncan's Multiple Range Test was used to assess multiple comparisons at a probability (p) of 0.05. One way analysis of variance (ANOVA) with replicates were used to analyse the significant difference among the results of samples

Results and Discussion

Physicochemical properties

The proximate composition of the vegetables examined in this study is presented in Table 1. The physicochemical parameters generally differed significantly ($p < 0.05$) from a leafy vegetable to another. All samples contained between 88.017 ± 0.018 % and 93.970 ± 0.058 % dry matter. This moisture content provides for lower activity of water soluble enzymes and co-enzymes needed for metabolic activities of these leafy vegetables. The ash content ranged from 6.001 ± 0.004 % (*Kogolémrou*) to 22.001 ± 0.003 % (*Anangobrou*). In view of their ash content, selected leafy vegetables could be considered as good minerals sources comparatively 2-10

% to cereals and tubers (FAO, 1986). There was a variation in the fibers content ranging from 15.082 ± 0.464 % (*Kogolémrou*) to 25.061 ± 0.005 % (*Fèfèbrou*). Results are in line with Acho *et al.*, (2014) fluctuating 11.49 % (*Corchius olitorus*) and 24.00% (*Colocassia esculenta*). Fiber intake has a number of health benefits, including maintenance of healthy laxation and the reduced risk of cardiovascular disease and cancer (Murphy *et al.*, 2012; Madhu *et al.*, 2017). Protein content varied from 17,002 ± 0,006 % (*Nanmougou*) to 28,001 ± 0,003 % (*kogolémrou*). Similar results were noticed with Oulaï *et al.*, (2014).

Nutritive and antinutritional properties

Table 2 shows nutritive and antinutritional properties of the selected leafy vegetables. Significant difference ($p < 0.05$) between most of these parameters was observed. Vitamin B9 content ranged from 731.333 ± 1.528 mg/100 g for *Anangobrou* to 11041± 1 mg/100 g for *Abôvi*. The vitamin B9 contents were considerably above the 400 µg daily intake recommended for folate. Many authors have noted significant amount of folate in fresh green leafy vegetables (Chew *et al.*, 2012, Maharaj *et al.*, 2015). Therefore, these leaves in general and those of *Abovi* in particular are good sources of folic acid and may be suggested for pregnant women in macrocytic anemia prevention, fetal malformations and for seniors in maintaining cardiovascular and cognitive health (FAO / WHO, 2004; Delchier *et al.*, 2016). The β-carotene content depended on the leafy vegetables species. *Fèfèbrou* had the highest value (0.309 ± 0.002 mg / 100 g). In Nigeria, Adegunwa *et al.*, (2011) reported β carotene levels in fresh leaves ranging from 0.240 to 0.264 mg / 100 g. According Sluijs *et al.*, (2015), diets high in β-carotene were shown to be associated with a reduced occurrence of type 2 diabetes. Adequate intake of these leafy vegetables could therefore be advantageous.

Table 2 showed total polyphenol at appreciable rates. *Kogolémrou* had the highest value with 9347 ± 21 mg/100 g. The substantial presence of polyphenol suggests a potential antioxidant activity. Wong *et al.*, (2006) showed that plants with an appreciable amount of polyphenols also exhibited strong antioxidant activity and contributed to their medicinal properties. Consumption of high levels of leaves could lead to reduce oxidative stress liable to cancer, cardiovascular and neurodegenerative diseases (Mullen *et al.*, 2007; Shen *et al.*, 2010).

Table.1 Physicochemical properties (%) of leafy vegetables (Dry basis)

Vernacular name	Dry matter	Ash	Crudefiber	Protein	Lipid
Fèfèbrou	88.017±0.018^{e}	12.333±0.003^{b}	25.061±0.005^{a}	18.001±0.004^{d}	18.680±0.016^{d}
Nanmougou	90.023±0.044^{d}	8.005±0,005^{d}	24.017±0.007^{b}	17.002±0.006^{e}	19.000±0.010^{c}
Kogolémrou	92.002±0.007^{b}	6.001±0.004^{e}	15.082±0.464^{e}	28.001±0.003^{a}	22.000±0.003^{b}
Abôvi	93.970±0.058^{a}	11.007±0.040^{c}	23.080±0.002^{c}	25.983±0.021^{b}	34.010±0.036^{a}
Anangobrou	91.334±0.010^{c}	22.001±0.003^{a}	18.893±0.004^{d}	22.673±0.003^{c}	13.000±0.004^{e}

The average values assigned to the same letter in the same column are not significantly different from the 5%

Table.2 Nutritive and antinutritional properties of leafy vegetables (mg / 100 g)

Vernacular name	Vitamin B9	β-carotene	Total polyphenols	Oxalates	Phytates
Fèfèbrou	740.000±1.000 ^{d}	0.309±0.002^{a}	4532±43^{d}	291±3^{c}	1103±3^{c}
Nanmougou	7250.333±1.528^{b}	0.290±0.002^{c}	5790±30^{c}	800±3^{a}	800±2^{e}
Kogolémrou	6291.000±1.000^{c}	0.305±0.002 ^{b}	9347±21^{a}	870±3^{a}	882±3^{d}
Abôvi	11041.000±1.000^{a}	0.156±0.002^{e}	4314±3^{e}	880±3^{a}	1280±3^{b}
Anangobrou	731.333±1.528^{e}	0.285±0.001^{d}	9203±3^{b}	312±2^{b}	1310±3^{a}

The average values assigned to the same letter in the same column are not significantly different from the 5%

Table.3 Mineral composition of leafy vegetables (mg / 100 g)

Vernacular name	K	Ca	Mg	Na	Fe	Mn	Cu	Zn
Fèfèbrou	3197±2^{c}	1588±2^{b}	647±2^{b}	1.0582±0.0002^{b}	0.4450±0.0002^{a}	0.1599±0.0002^{a}	0.0308±0.0002^{a}	0.0113±0.0002^{c}
Nanmougou	2288±2^{d}	183±3^{e}	589±2^{c}	0.2871±0.0002^{e}	0.3081±0.0002^{d}	0.0432±0.0019^{c}	0.0230±0.0002^{c}	0.0089±0.0002^{d}
Kogolémrou	1527±2^{e}	663±3^{d}	457±3^{d}	1.2347±0.0003^{a}	0.2460±0.0003^{e}	0.0342±0.0002^{e}	0.0312±0.0002^{a}	0.0032±0.0002^{e}
Abôvi	3324±2^{b}	1023±3^{c}	330±3^{e}	0.4680±0.0003^{d}	0.4050±0.0003^{c}	0.0391±0.0004^{d}	0.0174±0.0004^{d}	0.0182±0.0002^{b}
Anangobrou	7372±2^{a}	1629±3^{a}	1780±3^{a}	0.5272±0.0002^{c}	0.4370±0.0003^{b}	0.0752±0.0002^{b}	0.0282±0.0003^{b}	0.0288±0.0002^{a}

The average values assigned to the same letter in the same column are not significantly different from the 5%

Table.4 Different ratio of leafy vegetables

Vernacular name	[Na] / [K]	[oxalate] / [Ca]	[Phytate] / [Ca]
Fèfèbrou	0.0003	0.1832	0.6945
Nanmougou	0.0001	4.3715	4.3715
Kogolémrou	0.0008	1.3122	1.3303
Abôvi	0.0001	0.8602	1.2512
Anangobrou	0.0000	0.1915	0.8041

Antinutrient contents are shown in Table 2. Amounts varied from 291 ± 3 to 880 ± 3 mg /100 g for oxalates and 800 ± 2 to 1310 ± 3 mg/100 g for phytates. Antinutrient levels are higher than others authors but could reduce drastically by cooking, blanching and boiling (Ilelaboye *et al.*, 2013; Singh *et al.*, 2015).

Mineral composition

Mineral grades were noted in Table 3. Amounts of potassium ranged from 1527 ± 2 to 7372 ± 2 mg / 100 g respectively for *Kogolémrou* and *Anangobrou.* Sodium and potassium are involved in membrane and cellular exchange, thus contributing to the regulation of plasma volume, acid-base balance and muscle contraction (Akpanyung, 2005). The calcium levels were between 183 ± 3 mg / 100 g (*Nanmougou*) and 1629 ± 3 mg / 100 g (*Anangobrou*). Calcium plays a major role in ossification and dentition and has a preventive effect on arterial hypertension in the elderly (Turan*et al.*, 2003). All the analyzed plants were excellent sources of magnesium, ranging from 330 ± 3 mg /100 g (*Abôvi*) to 1780 ± 3mg /100 g (*Anangobrou*). Magnesium is a cofactor in over 300 enzymatic reactions that regulate various biochemical reactions in the body including protein synthesis, muscle function, blood glucose, blood pressure and heart rate regulation (Rude *et al.*, 2009). The analyzis showed that *Fèfèbrou* was the richest in fresh

iron with 0.4450 ± 0.0002 mg / 100 g while *Kogolémrou* had the highest sodium content. Manganese, copper and zinc were quantified respectively between 0.0342 ± 0.0002 and 0.1599 ± 0.0002, 0.0174±0.0004 and 0.0312±0.0002, 0.0032±0.0002 and 0.0288±0.0002. Copper is the major constituent of cuproenzymes, which are involved in energy production, iron metabolism and the metabolism of neurotransmitter synthesis (Mejía-Rodríguez *et al.*, 2013). Iron plays an important role in the prevention of anemia while Zinc is important in neurological function (Yamada *et al.*, 2014). Considering the recommended dietary allowance (RDA) for minerals, calcium (1000 mg/day); magnesium (400 mg/day), iron (8 mg/day) and zinc (6 mg/day) these leafy vegetables could cover RDA and contribute substantially for improving human diet (IOM, 2005).

All the samples analyzed had their sodium/ potassium ratio less than 1 (Table 4). They could be used in diets of hypertensive individuals. Excepted *Nanmougou*, the oxalate/calcium and the phytates/Calcium ratios were lower than 2 (Table 4). The calculated Oxalates/Calcium and Phytates/ Calcium ratios in all the species, excepted *Nanmougou*, were below the critical threshold of 2.5 known to affect calcium bioavailability (Hassan *et al.*, 2007).

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References

Acho, C., Zoué, L., Akpa, E., Yapo, V. andNiamké, S., 2014. Leafy vegetables consumed in southern Côte d'Ivoire: a source of high value nutrients. *J. Anim. Plant Sci.*, 20: 3159-3170.

Adegunwa, M.O., Alamu, E.O, Bakare, H.A. andOyeniyi, C.O., 2011. Proximate and bioactive contents of some selected vegetables in Nigeria: Processing and Varietal effects. *Am. J. Food Nutr.*, 1: 171-177.

Akpanyung, E.O., 2005. Proximate and mineral composition of bouillon cubes produced in Nigeria. *Pak. J. Nutr*., 4: 327-329.

AOAC., 1990. Official Method of Analysis. 15th ed. Association of Official Analytical Chemist, Washington, DC. USA.

Augustino, S., Mataya, B., Senelwa, K. andAchigan-Dako, E.G., 2011. Non-wood forest products and services for socio-economic development. In: A Compendium for Technical and Professional Forestry Education. The African Forest Forum, Nairobi, Kenya.

Chew, S.C, Loh, S.P. and Khor, G.L., 2012. Folate content and availability in Malaysian cooked foods. *Mal. J. Nutr*., 18: 383-391.

Day, R.A. and Underwood, A.L., 1986. Quantitative analysis. 5th edn. Prentice Hall. 701 p.

Delchier, N., Herbig, A., Rychlik, M. andRenard, C., 2016. Folates in fruits and vegetables: contents, processing and stability. *Compr. Rev. Food Sci. Food Saf.*, 15: 506-528.

FAO, 1986. Food composition table for use in Africa. FAO Ed, Rome, Italy.

FAO, 1988. Traditional food plants. FAO Food and nutrition paper. FAO, Rome, N°42.

FAO/WHO, 2004. Vitamin and mineral requirements in human nutrition. 2nd Edn., Rome.

Fondio, L., Kouamé, C., N'zi, J.C., Mahyao, A., Agbo, E. and Djidji, A.H., 2007. Survey of indigenous leafy vegetable in

the urban and periurban areas of Côte d'Ivoire. *Acta Hortic.*, 752: 287-289.

Hasan, M. N., Akhtaruzzaman, M. and Sultan, M. Z., 2013. Estimation of Vitamins B-Complex (B2, B3, B5 and B6) of Some Leafy Vegetables Indigenous to Bangladesh by HPLC Method. *J. Anal. Sci. Meth. Instrum.*, 3: 24-29. http://dx.doi.org/10.4236/jasmi.2013.33A004.

Hassan, L.G, Umar, K.J. and Umar, Z., 2007. Antinutritive factors in *Tribulus terrestris* (Linn) leaves and predicted calcium and zinc bioavailability. *J. Trop. Biosci.*, 7: 33-36.

Ilelaboye, N. O. A., Amoo, I. A., andPikuda, O. O., 2013. Effect of cooking methods on mineral and anti nutrient composition of some green leafy vegetables. *Arch. Appl. sci. Res*., 5(3): 254-260.

Institute of Medicine, 2005. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, FattyAcids, Cholesterol, Protein, and AminoAcids. Washington, DC: The National AcademiesPress. https://doi.org/10.17226/10490.

Li, M., Fan, Y., Zhang, X., Hou, W. and Tang, Z.,2014. Fruit and vegetable intake and risk of type 2 diabetes mellitus: meta-analysis of prospective cohort studies. *BMJ Open*, 4:e005497. http://dx.doi.org/10.1136/bmjopen-2014-005497.

Madhu, C., Krishna, K. M., Reddy, K. R., Lakshmi, P. J. and KumarKelari, E., 2017. Estimation of Crude Fibre Content from Natural Food Stuffs and its Laxative Activity Induced in Rats. *Int. J. Pharma. Res. Health Sci.*, 5(3): 1703-06.

Maharaj, P.P., Prasad, S., Devi, R. and Gopalan, R., 2015. Folate content and retention in commonly consumed vegetables in the South Pacific. *Food Chem.*, 182: 327-332.

Mejía-Rodríguez, F., Shamah-Levy, T., Villalpando, S., García-Guerra, A. and Méndez-Gómez, H. I., 2013. Iron, zinc, copper and magnesium deficiencies in Mexican adults from the National Health and Nutrition Survey 2006. *Salud Publica Mex.*, 55: 275-284.

Miglio, C., Chiavaro, E., Visconti, A., Fogliano, V. and Pellegrini, N., 2008. Effects of different cooking methods on nutritional and physicochemical characteristics of selected vegetables. *J. Agric. Food Chem.*, 56: 139-147.

Mohammed, A.I., Ponnamperuma, A.J. and Hafez, Y.S., 1986. New chromophore method for phytic acid determination. *Am. Assoc. Cereal. Chem.*, 63: 475-478.

Mohammed, M.I. and Sharif, N., 2011. Mineral composition of some leafy vegetables consumed in Kano, Nigeria. *Nig. J. Basic Appl. Sci.*, 19: 208-211.

Mullen, W., Marks, S.C. and Crozier, A., 2007. Evaluation of phenolic compounds in commercial fruit juices and fruit drinks. *J. Agr Food Chem.*, 55: 3148-3157.

Murphy, N., Norat, T., Ferrari, P., Jenab, M., Bueno-de-Mesquita, B., Skeie, G *et al.*, 2012. Dietary Fibre Intake and Risks of Cancers of the Colon and Rectum in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Plos One*, 7(6): e39361. https://doi.org/10.1371/journal.pone.0039361

N'Dri, D., Mazzeo, T., Zaupa, M., Ferracane, R., Fogliano, V. and Pellegrini, N., 2013. Effect of cooking on the total antioxidant capacity and phenolic profile of some whole-meal African cereals. *J. Sci. Food Agric.*, 93: 29-36. https://doi.org/10.1002/jsfa.5837.

Nnamani, C.V., Oselebe, H. andAgbatutu, A., 2009. Assessment of nutritional values of three underutilized indigenous leafy vegetables of Ebonyi State, Nigeria. *Afr.*

J. Biotechnol., 8: 2321-2324.

Oulai, P.D., Zoué, L.T., Megnanou, R., Doué, R. and Niamké, S.L., 2014. Proximate composition and nutritive value of leafy vegetables consumed in northern Côte d'ivoire. *Eur. Sci. J.*, 10: 1857–7881.

Oulai, P.D., Zoué, L T. and Niamké, S.L. 2015. Evaluation of nutritive and antioxidant properties of blanched leafy vegetables consumed in northern Côte d'Ivoire. *Pol. J. Food Nutr. Sci.*, 65: 31–38.

Plant Resources of Tropical Africa – PROTA. 2004. Ressources végétales de l'Afrique tropicale. Volume 2: Legumes. G.J.H. Grubben, O.A. Denton (Eds). Fondation PROTA, Backhuys Publishers, CTA, Wageningen. p. 737.

Raghuvanshi, R.S. and Singh, R., 2001. Nutritional composition of uncommon foods and their role in meeting in micronutrient needs. *Int. J. Food Sci. Nutr.*, 32: 331-335.

Rude, R.K, Singer, F.R. and Gruber, H.E., 2009. Skeletal and hormonal effects of magnesium deficiency. *J. Am. Coll. Nutr.*, 28: 131-141.

Shen, S.S., Callaghan, D., Juzwik, C., Xiong, H.Q., Huang, P.L. and Zhang, W.D., 2010. ABCG2 reduces ROS-mediated toxicity and inflammation: A potential role in Alzheimer's disease. *J. Neurochem.*, 114: 1590-1604.

Singh, S., Swain, S., Singh, D. R., Salim, K. M., Nayak, D., and Roy, S. D., 2015. Changes in phytochemicals, anti-nutrients and antioxidant activity in leafy vegetables by microwave boiling with normal and 5% NaCl solution. *Food chem.*, 176: 244-253.

Singleton, V.L., Orthofer, R. and Lamuela-Raventos, R.M., 1999. Analysis of total phenols and other oxydant substrates and antioxydants by means of Folin-ciocalteu reagent. Methods Enzymol., 299: 152-178.

Sluijs, I., Cadier, E., Beulens, J.W.J., Spijkerman, A.M.W. and van der Schouw, Y.T., 2015. Dietary intake of carotenoids and risk of type 2 diabetes. *Nutr. Metab. Cardiovasc. Dis.*, 25: 376-381.

Soro, L.C., Atchibri, L.O, Kouadio, K.K. andKouamé, C., 2012. Evaluation de la composition nutritionnelle des légumes feuilles. *J. Appl. Biosci.*, 51: 3567-3573.

Turan, M., Kordali, S., Zengin, H., Dursun, A., Sezen, Y., 2003. Macro and micro-mineral content of some wild edible leaves consumed in Eastern Anatolia. *Plant Soil Sci.*, 53: 129-137.

Wong, S.P., Leong, L.P. and Koh, J.H.W., 2006. Antioxidant activities of aqueous extracts of selected plants. *Food Chem.*, 99: 775-783.

Yamada, M., Asakura, K., Sasaki, S., Hirota, N., Notsu, A., Todoriki, H, Miura, A., Fukui, M. and Date, C., 2014. Estimation of intakes of copper, zinc, and manganese in Japanese adults using 16-day semi-weighed diet records. *Asia Pac. J. Clin. Nutr.*, 23:465–472.

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