

Nutritive value of banana

Suzanne Sharrock and Charlotte Lusty

Preparing a
Philippine dish
called "Maruya"
with deep-fried Saba
bananas dipped
in batter.
(Photo: G. Molina,
INIBAP)



Introduction

Bananas and plantains are one of the world's most important food crops. Plantains and a wide range of other cooking and dessert banana varieties provide a staple food for millions of people in the developing countries of the tropics, while exported bananas are ranked as the world's most valuable fruit crop. This article examines the nutritional value of this popular, multi-purpose crop, providing information on the chemical composition of the fruit and comparing its nutritional value with other starchy staples and fruits.

The nutritional value of any food depends on a wide range of variables, such as its ripeness, the climatic conditions under which it is grown, the quality of the soil, and of particular importance here –the variety. In addition, important differences result from the method of preparation – frying in contrast to boiling for example. Further variation can be introduced according to the techniques used for analysing the exact nutrient content of the food. Given these possible sources of error and variation, the data provided in this paper should be taken as 'best estimates' based on a range of data sources.

Chemical composition

The pulp of a ripe banana is essentially a sugar-rich, easily-digested food. The cooked banana is nutritionally similar to the potato. It contains about 70% water; solid material is mostly carbohydrate (27%); fat (0.3%) and protein (1.2%) contents are generally low. In energy terms, each gram provides one calorie. Eleven vitamins have been recorded and the fruit is considered a good source of vitamins A, B1, B2 and C (Table 1).

The main difference between a banana and a plantain is moisture content. The plantain averages about 65% moisture and the banana about 83%. Since hydrolysis, the process by which starches are converted to sugars, acts fastest in fruit of high moisture content, starches are converted to sugars faster in bananas than in plantains. Many cooking bananas have moisture contents that fall in between plantains and dessert bananas. These varieties can be cooked when not completely ripe, but will also ripen sufficiently to be eaten raw.

Carbohydrates

The energy value of a food derives from the sum of its carbohydrate, fat and protein content. In the case of banana and plantain, the carbohydrate fraction is by far the most important. The sugars and starches that make up this fraction are present in varying concentrations according to the state of the fruit's ripeness. The major change during the ripening process in both bananas and plantains is the conversion of starch to sugar.

In unripe plantains, starch comprises over 80% of the dry weight of the pulp. The two main components of this starch are amylose and amylopectin, present in a ratio of around 1:5. Sugars comprise only about 1.3% of total dry matter in unripe plantains, but this rises to around 17% in the ripe fruit (Ogazi, 1995). In bananas, starch levels in the unripe fruit are around 20%, and this declines to 1-2% in fully ripe fruit, while at the same time the soluble sugar increases from less than 1% to 20%. During ripening, the sugars are in the approximate ratio of glucose 20 : fructose 15 : sucrose 65. Only traces of other sugars are found (Simmonds, 1966). As there is a close correlation between the starch-sugar ratio and peel colour, the ripening process is marked by the peel turning yellow.

The high sugar content in a ripe banana is unusual in a fresh fruit. It supplies almost double the energy of an apple and nearly three times that of citrus fruits (Table 1).

Fibre

Non-starch polysaccharides (collectively known as fibres) include crude fibre, cellulose, pectic

Table 1. Nutritional values for the plantain and banana (per 100 g raw edible portion) from the United States Department of Agriculture (USDA) nutrient database (<http://www.nal.usda.gov>).

| | Banana | Plantain | Sweet potato | Potato | Cassava | Apple |
|--------------------------|--------|----------|--------------|--------|---------|-------|
| Water (g) | 74.26 | 65.28 | 72.84 | 78.96 | 59.68 | 83.93 |
| Energy (kcal) | 92 | 122 | 105 | 79 | 160 | 59 |
| Protein (g) | 1.03 | 1.3 | 1.65 | 2.07 | 1.36 | 0.19 |
| Fat (g) | 0.48 | 0.37 | 0.30 | 0.10 | 0.28 | 0.36 |
| Carbohydrate (g) | 23.43 | 31.89 | 24.28 | 17.98 | 38.05 | 15.25 |
| Calcium (mg) | 6 | 3 | 22 | 7 | 16 | 7 |
| Iron (mg) | 0.31 | 0.6 | 0.59 | 0.76 | 0.27 | 0.18 |
| Potassium (mg) | 396 | 499 | 204 | 543 | 271 | 115 |
| Sodium (mg) | 1 | 4 | 13 | 6 | 14 | 0 |
| Vitamin C (mg) | 9.1 | 18.4 | 22.7 | 19.7 | 20.6 | 5.7 |
| Thiamin (mg) | 0.045 | 0.052 | 0.066 | 0.088 | 0.087 | 0.017 |
| Riboflavin (mg) | 0.100 | 0.054 | 0.147 | 0.035 | 0.048 | 0.014 |
| Niacin (mg) | 0.540 | 0.686 | 0.674 | 1.484 | 0.854 | 0.077 |
| Vitamin A (IU) | 81 | 1127 | 20063 | 0 | 25 | 53 |
| Saturated fats (g) | 0.185 | 0.143 | 0.064 | 0.026 | 0.074 | 0.058 |
| Monounsaturated fats | 0.041 | 0.032 | 0.011 | 0.002 | 0.075 | 0.015 |
| Polyunsaturated fats (g) | 0.089 | 0.069 | 0.132 | 0.043 | 0.048 | 0.105 |

substances, hemicellulose and other polysaccharides. Unripe plantain pulp has a total of 3.5% dry matter as cellulose and hemicellulose and therefore constitutes a good source of dietary fibre.

Protein

In relation to dry weight, total protein value of plantains is around 3.5% in ripe pulp, slightly less in unripe fruit and in bananas. As a starchy staple food, plantains supply about 1 g protein/100g edible portion (Table 1). As a healthy adult requires about 0.75 g protein/kg/day, plantains alone cannot meet adult protein needs. The amino acids with the highest concentrations in plantains are arginine, aspartate and glutamine. The most limiting amino acid is methionine, and since soybean is relatively rich in this, plantain and soybeans make a good nutritious combination.

Fats

The fat content of plantains and bananas is very low, less than 0.5%, and so fats do not contribute much to the energy content. Although the total lipid content remains essentially unchanged during ripening, the composition of fatty acids, especially within the phospholipid fractions has been observed to change, with a decrease in their saturation (Ogazi, 1996).

Vitamins

Bananas and plantains are a good source of vitamins A (carotene), B (thiamin, niacin and riboflavin and B6) and C (ascorbic acid) (Table 2). Processing and cooking will affect the vitamin content, thus bananas eaten ripe provide a better source of vitamins than cooked bananas and



Cooking bananas in the Philippines for selling at market. (Photo: G. Molina, INIBAP)

plantains. In their raw state, plantains are actually richer in vitamin C than bananas. In comparison with other starchy staples, vitamin C content is similar to sweet potato, cassava and potato. Vitamin A levels vary within and between varieties. Plantains provide a better source of vitamin A than most other staples. The potato, cassava and cereals provide virtually no vitamin A at all. Vitamin B is present in significant quantities in banana beer, a brew widely drunk in the highlands of Eastern Africa. This is because the yeast used in brewing is high in B vitamins.

Minerals

Although bananas and plantains do not provide a particularly good source of several important minerals in human nutrition, such as calcium, iron and iodine, they are notably high in potassium and low in sodium.

Nutritive value

Source of energy

Ripe bananas are one of the most rapidly digested foods (Table 3). Eating several ripe bananas provides a readily available supply of hundreds of calories. For this reason, bananas are recommended to people who need large amounts of glucose in their blood to maintain adequate

Table 2. Percentage of U.S. Recommended Daily Allowance of vitamins and minerals provided by 100 g of banana (From Byers Food Nutritional Fact Bananas. <http://byersfood.com/nutrition/bananas.html>).

| Vitamins | | Minerals | |
|------------|-----|------------|---|
| Vitamin | % | Mineral | % |
| B6 | 29 | Magnesium | 7 |
| C | 15 | Copper | 6 |
| A | < 2 | Iron | 2 |
| Folacin | 5 | Phosphorus | 2 |
| Thiamin | 3 | Zinc | 6 |
| Riboflavin | 5 | | |
| Niacin | 3 | | |

levels of muscle action. This includes particularly sports players and manual labourers.

Value as a staple food

A sedentary adult has an energy requirement of around 2,400 calories per day. If this is all to be supplied from bananas or plantains, it would mean eating about 24 fruit per day. Such a diet would by itself be unsatisfactory, being deficient in fat and protein, but it would be balanced by the addition of abundant milk.

The energy density of bananas and plantains is, in fact, fairly typical of other starchy staples, but in comparison with cereals they do badly. In their dry state, rice, wheat flour and maize all have nearly triple the energy value of plantains. However, the amount of water absorbed during preparation has a major impact on energy density. Plantains are considered palatable at a lower water content than maize, thus boiled and mashed banana or plantain may prove to be a higher energy staple than maize porridge (Chandler, 1995). Similarly, the calorie value of rice drops by almost two thirds when boiled, to only 123 kcal/100g. If plantain is prepared by frying, the oil used will considerably boost its energy value.

| | |
|-------------------------|----------------------------|
| e.g. energy value/100g: | raw green fruit: 112 kcal |
| | boiled fruit: 122 kcal |
| | ripe fried fruit: 267 kcal |

(Chandler, 1995)

Protein value

As mentioned above, plantains are low in protein content. Such deficiency is likely to be most significant for growing children. Small children have a proportionally higher energy and protein need than do adults and yet they have a lower capacity to take in foods. For example, a boy of 2-3 years needs an estimated daily average energy intake of around 1,350 kcal. In plantain terms, this means, 1 kg of food, but this will only provide 10 g of the 15 g of protein recommended. Therefore a child living on an unsupplemented plantain diet must accommodate over a kilogram of the fruit per day. This may be difficult for a three-year-old



Selling "turon" (Saba bananas wrapped in flour and sugar) and banana-cue (sugar-coated, deep-fried Saba bananas) in the Philippines. (Photo: G. Molina, INIBAP)

stomach. For children, therefore, it is especially important that a plantain diet is complemented by other foods of greater energy and protein density, beans or meat for example. This is normally the case. Where starchy bananas provide the staple food, it is customary for them to be prepared with another food or with a sauce (Chandler, 1995).

Therapeutic value

Ripe bananas, being one of the most easily digested foods (Table 3), are widely used in the nutrition of infants and of people suffering from various intestinal disorders. Bananas also have a special place in diets low in fats, cholesterol and salt. Sodium is present in trace amounts while the potassium level is around 400 mg/100g pulp. Because of the low lipid and high energy value, bananas are recommended for obese and geriatric patients. Bananas are useful for the treatment of peptic ulcers, infant diarrhoea, in coeliac disease (sufferers of this disease normally have a marked intolerance to carbohydrates, but are able to digest bananas readily) and in colitis. The high carbohydrate and low fat content of the banana makes it suitable for low fat diets.

Blood pressure

Certain compounds in banana behave like angiotensin-converting enzyme (ACE) inhibitors. ACEs govern the release of angiotensin-2, a substance which has the effect of causing a rise in blood pressure through the constriction of blood vessels. Indian researchers report the ACE-inhibiting properties in six varieties of bananas. This finding confirms earlier studies in USA suggesting that potassium-rich foods such as banana help reduce blood pressure. In tests in India, two bananas a day resulted in 10% drop in blood pressure within a week (Anon, 1999).

Anti-nutritional factors

Many starchy staples contain small amounts of potentially toxic substances and anti-nutritional factors such as trypsin inhibitors. For example, cassava contains toxic cyanogenic glycosides and the potato, glycoalkaloids. In contrast, bananas and plantains do not contain significant levels of any toxic compounds. They do however contain high levels of serotonin, dopamine and other biogenic amines. Dopamine is responsible for the enzymic browning of sliced bananas. Reports that serotonin intake at high levels from plantain is implicated in the aetiology of endomyocardial fibrosis (EMF), a thickening of the heart wall (Foy and Parratt, 1960), have now been largely discounted (FAO, 1990).

Global nutrition

Humans have been gaining nutrients from bananas for several thousand years. For the last hundred years it has been one of the few food crops to be enjoyed on a truly worldwide scale, on the tables of families, from the highest-income to the lowest in all parts of the world. Its texture, taste, its convenience, ease to eat, and low cost to grow, as well as its nutritional value, have all contributed to this success. Whether sweet or savoury the banana has a considerable, if frequently undervalued, role to play in global human nutrition.

References

- Anon. 1999. Two is enough - really. Sweet tidings on treating high blood pressure. Asiaweek March 19, 1999.
- Chandler S. 1995. The nutritional value of bananas. Pp; 486-480 in *Bananas and Plantains* (S. Gowen, ed.), Chapman & Hall, UK.
- FAO. 1990. Roots, tubers, plantains and bananas in human nutrition. FAO, Rome, Italy.
- Foy and Parratt. 1960. A note on the presence of noradrenaline and 5-hydroxytryptamine in plantain. *J. Pharm. Pharmacol* (12): 360-364.
- Ogazi P.O. 1996. Plantain: production, processing and utilisation. Paman and Associates Ltd., Nigeria.
- Simmonds N.W. 1966. *Bananas*. 2nd ed. Longman, London, UK.

Table 3.
The duration of digestion for diverse foods.

| Food type | Minutes |
|---------------|---------|
| Ripe bananas | 105 |
| Courgette | 105 |
| Haricot beans | 150 |
| Orange | 165 |
| Milk | 165 |
| Roast mutton | 195 |
| Cooked eggs | 210 |
| Apple | 210 |
| Cabbage | 270 |
| Roast pork | 320 |