Panela: the natural nutritional sweetener

GAYLE DE MARIA
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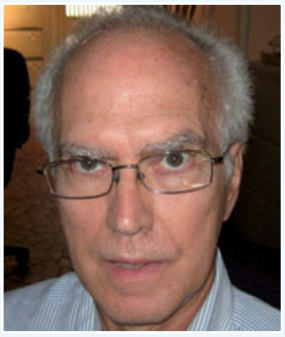
Gayle De Maria

During my visit to Vitafoods exhibition I met Catherine Correal, ambassador of Fedepanela, and had an interesting exchange of information and opinions on a natural sweetener called Panela. This meeting was followed by an in depth literature analysis of this functional food and in order to gain more information on it, we decided to interview an expert on Panela, Walter Jaffe, director of Panela Monitor, supported by Catherine Correal.

Could you make a description of the composition of Panela?

Panela is unrefined, non-centrifugal sugar (NCS), a natural nutritional sweetener. The concentrated product of sugarcane juice (Saccharum officinarum L.), Panela is a natural product produced by the boiling and drying of sugarcane juice allowing for the retention of the essential constituents of sugar cane including: trace minerals, vitamins, amino acids, protein and antioxidants. Panela is a valued traditional foodstuff in many sugarcane producing countries in Latin America, Caribbean, Asia and Africa.
Although published data on Panela composition is relatively scarce and the range of values for components is large, reflecting different cane varieties, agronomical and process conditions, sucrose is the most important component, between 73 and 90%, followed by reducing sugars (4 – 14%) and water. Reducing sugars are half glucose, half fructose. The mineral content (ashes) is high (0.6 – 2.5%). Protein content ranges between 0.35 and 0.87% and fats between 0.1 and 0.6%. The basic difference between the NCS Panela and refined centrifugal (a.k.a. refined sugar) is the presence of reducing sugars and of significant quantities of minerals and other minor constituents present in Panela. These nutritional and functional differences of NCS Panela are due to the differences in production. Panela is not subjected to a centrifugal process that separates the molasses and crystals, allowing Panela to retain all of the natural benefits of sugarcane such as calcium, chloride, potassium, phosphorus, sodium, magnesium, iron, manganese, copper, zinc, chromium, cobalt, Vitamins A, Beta Carotene, Thiamin, Riboflavin, Niacin, Pantothenic acid and Vitamin C.
The published data on mineral content in Panela indicates that calcium, chloride and potassium are present in the order of 100 mg/100g, followed by phosphorus, sodium and magnesium (10 mg/100g) and iron and manganese (1 mg/100g); copper and zinc (0.1 mg/100g); and chromium and cobalt (0.01 mg/100).
Since the identification in the 1960's of phenolic compounds in sugarcane molasses, several reports of their presence in NCS Panela have been published. They show that the Panela from different countries (Japan, India, Reunion/France, Venezuela) have similar and significant phenolic content, in the range of 0.2 – 0.5 g GAE/100g, as measured by the Folin-Ciocalteu method. Since the first report of antioxidant phenolic glycosidic compounds in Japanese NCS Panela by Nakasone et al. in 1996 (1), at least 26 antioxidant phenolic compounds in Panela have been reported to date (2-6).
Other minor components are organic acids, amino acids, aldehydes, alcohols and various volatile compounds.

Catherine M. Correal
Managing Partner of
CORSCH GmbH (Switzerland)
CORSCH SAS (Colombia),
Ambassador of FEDEPANELA



Walter Jaffe
General Manager INNOVAL C.A.,
Director of Panela Monitor

There seems to exist a scientific background of the Non-Centrifugal Sugar (NCS). What are the most representative health effects reported for NCS?

Panela is valued for both its nutritional and medicinal benefits and is considered by many to be a healthy alternative to refined sugar and artificial sweeteners. Panela is a high energy sweetener appreciated by athletes. In developing countries Panela is recommended in pre-natal care and for children development including the prevention of anemia due to its high calcium and iron level and nutritional value contribution. Panela consumption is also recommended in order to prevent osteoporosis. Panela provides the body the energy it needs for proper development and function of the vital organs such as the muscles, tissues and the brain which all use glucose as a source of energy. The level of glucose in Panela is said to prevent: weakness, tremors, mental clumsiness, fainting or hypoglycaemia. Additionally, Panela is effective in treating cold and flu symptoms. Used topically it heals scrapes and wounds.
Scientific studies show the functional and health properties of NCS Panela to include:

- Protects teeth, preventing against teeth decay.
- Immunological effects
- Natural Antioxidant
- Effective in preventing diabetes & hypertension
- Strengthens bones

- Antimicrobial effects
- Anticarcinogenesis properties
- Cytoprotective qualities
- Reduces iron deficiency anaemia
- Anti-atherosclerosis effects

The health effects which seem to be the most promising and important in the short term concern the ready adsorption of the iron it contains in relatively high levels, which reduces anaemia, and the anti-arsenic-toxicity effect. Both of these health effects are highly relevant to important public health issues in many countries. Anaemia is an important global health issue in developing countries as well as arsenic intoxication from ground water, a topic of great interest in countries such as Bangladesh and India.
Firm evidence for anti-atherosclerosis effects of NCS Panela exists. In animal models, supplementation of the diet with NCS Panela and with phenolic compounds extracted from it significantly reduced the development of atherosclerosis as compared to the ingestion of sucrose. Extracts from NCS Panela have also been shown to have significant immunological effects that is, growth promoting, immune-stimulating, adjuvant and infection protective effects of their oral administration, and of polyphenol-rich fractions of them, in chicken, pigs and mice.

Could you highlight the most interesting compounds in Panela responsible for such health effects?

Iron is the component responsible for the anti-anaemia effect of Panela, helped by its high bio-availability, allowing for its ready adsorption in the human intestine. The rest of the reviewed health effects of Panela such as the anti- atherosclerosis and anti-toxicity and anti-radiation effects are attributed to the presence of anti-oxidative components and particularly polyphenols. Polyphenols and other antioxidants are thought to protect cell constituents against oxidative damage through scavenging of free radicals. But increasingly it is becoming clear that the effects are much broader. Evidences for direct interactions of them with receptors or enzymes involved in cellular signal transduction, for example, shows that their effect on the redox status of the cells goes beyond their scavenging of free radicals. The biological effects of polyphenols therefore may well extend beyond oxidative stress. The natural antioxidant capabilities of NCS Panela have recently been studied by the Universidad Politécnica de Valencia (7) . Other studies have determined the oxygen radical absorbance capacity (ORAC), a popular method of measuring the antioxidant activities, as 26,400 µmol TE x 100 gr in Panela, which is more than berries and nuts but less than cocoa and chocolate.
Despite the high level of perceived sweetness of Panela, studies have shown that NCS Panela does not contribute to tooth decay. The protective effect of Panela on the decalcification of teeth was first published in 1937 by Osborn (8). Additional independent studies from the Swiss paediatrician Max Henri Béguin (1978) (9) and in 2006 Colombian microbiologists Duke, Rincon and Ocampo (10) concluded that cavities were significantly lower in infantile populations that consumed Panela. This was explained by the presence of phosphorus and calcium that enable tooth structure development and the presence of potassium and magnesium which neutralize excessive acidity, one of the principal causes of tooth decay.

Nutritional value per 100g		EU RDA
Energy	1633 kJ/390 kcal	8373kJ/2000 kcal
Protein	1.10 g	50g
Carbohydrates	96 g	250
Dietary Fiber	0.24 g	38g
Fat	0.12 g	67g
Minerals		
Calcium	403.11 mg	800 mg
Phosphorus	3.77 mg	700 mg
Iron	7.46 mg	14 mg
Magnesium	Max 36.52 mg	375 mg
Sodium	64.70 mg	2300 mg
Potassium	Max 302.59 mg	2000 mg
Copper	0.011mg	1 mg
Zinc	0.13mg	10 mg
Vitamins		
Vitamin A	Max 277 µl	800 µl
Vitamin C	Max 1.31 mg	80 mg

Panela Nutritional Values

What would be your recommendation of Panela consumption on a daily basis?

A good start would be to substitute all refined centrifugal and other non-nutritional and non-caloric sweeteners for the consumption of the easy to use powdered Panela for quick individual use as a sweetener and as a sweetener in industrially produced foods.
The table above depicts the nutritional value of one industrially produced low-humidity, fine grained Panela currently available on the market. The contribution to the EU RDA by consuming 100 g daily of Panela would be very significant source, more than 30% of carbohydrates, dietary fibre, calcium, iron and Vitamin A.
The health advantages of Panela compensate the negative effect of sucrose calories in the diet. A complete substitution of refined centrifugal sugar for Panela is recommended in order to receive the health benefits for all consumers: adults, children, women in childbearing years, women in menopause, seniors and athletes. Additionally the use of Panela in industrially produced foods as a sweetener to replace refined sugars, HFCS and artificial sweeteners is recommended.

In your opinion, which is the most important advantage of Panela compared to regular (centrifugal) sugar?

The most important advantage is the complexity of Panela as a nutritional and functional food due to its many bioactive components. Refined centrifugal sugar is an extremely simple, highly refined product as it contains only sucrose which in excess has negative effects upon health as well as empty calories. Because Panela is dried sugarcane juice, all of the natural properties of sugarcane are maintained making NCS Panela a viable source for energy, minerals, proteins and vitamins – essential body constituents. Centrifuged sugar on the other hand is 99% sucrose – and empty calories. Panela consumption fortifies the body's functioning process while providing sweetening capabilities for all ages, genders and cultures. Panela stimulates the senses providing that extra natural burst of energy as well as vitamins and minerals that could be enjoyed by *all* consumers: children, teens, adults and seniors without any negative side effects. No animal products are used in the production of Panela, allowing Panela to be consumed by vegetarians whereas refined centrifugal sugars are known to use bone-char in the production process. If produced from non-GMO sugarcane it would be GMO free, which is the most common case.

Is there any advantage in consuming Panela compared to non-caloric sweeteners?

Panela has several advantages compared to non-caloric sweeteners. The most important one is its positive health effects received by consuming Panela considering that artificial non-caloric sweeteners have none or, to the contrary, are suspected of having negative health effects including supposed links to cancer as well as complaints of neurological or psychiatric side effects. Panela is a natural product that does not use chemicals in its production process, nor does it comprise of chemicals in its composition. Panela is a natural product. Artificial sweeteners provide little or no food energy a vital bodily constituent.
The natural sweetness of Panela does not cause the problematic after-taste or mouth feel of several non-caloric sweeteners, including natural non-caloric sweeteners.
Panela has a rich full bodied natural taste characterized as slightly malty. Using Panela as a sweetener in foods or drinks will enhance the flavour of the final product for either hot or cold liquid or ready-mix beverages (fruit drinks, smoothies, colas, milk or whey based drinks, energy drinks, refreshing drinks, cocktails, etc) or as foodstuffs (ready-mixes or final products) such as puddings, baked-goods, marmalades, protein/energy/weight control bars, desserts, confectionary and chocolate products – to name a few.

Make a comparison of the price per serving or daily intake of Panela compared to regular sugar or non-caloric sweeteners

The higher price per serving of Panela compared to refined centrifugal sugar and to some non-caloric sweeteners is due to its production economics (i.e. specific requirements and conditions), technical innovation and price elasticity
Panela is not an internationally traded good within any commodity board of trade, as is refined centrifugal sugar, and as such has a local pricing scheme defined by supply and demand. In Latin America, Panela can be considered an elastic product in local markets located nearer to urban centres where substitution of Panela for refined centrifugal sugar for sweetening purposes occurs if the price of refined centrifugal sugar is much lower than NCS Panela. In these same local markets, Panela consumption for medicinal purposes (treating colds or wounds) or as a "feel good" product, can be considered an inelastic good where even with the increase in price, the demand remains proportional.
Specific production requirements and climate conditions are necessary to process Panela. The sugarcane used for Panela production is typically produced on mountainous terrain by small rural producers in smaller extensions of land characterized by special micro climates with large temperature fluctuations between day and night. There are lower levels of mechanization and innovation in sugarcane fields for Panela than sugarcane fields for refined centrifugal sugar which operate in mechanized flat-land operations and with higher yields and with economies of scale. Recent innovation into the Panela production sector is allowing the export prices of the new low humidity, fine-grained (11) Panela to become more competitive internationally for industrial use and for direct consumption. It is expected that the economies of scale will take effect with the newly developed technology as installed capacity and demand increases.
It is important to remember that Panela is considered a functional food and nutriceutical. The use of Panela is first and foremost to provide a nutritional source of energy for proper bodily function. The use of Panela as a sweetener results in the flavour enhancement for food and beverages. Panela is a natural nutritional sweetener; the nutritional and health benefits outweigh the increased price. These benefits compensate for the price differential.

What were the reasons for the low consumption of Non-Centrifugal Sugar in the sweeteners market?

The main reasons for low consumption of NCS in the sweeteners market are lack of awareness, identity problems, image problem, and colour and until recently a lack of innovation. According to a recent publication by W. Jaffe from the Panela Monitor (12), scientific research confirms that NCS Panela has multiple health effects but still remains outside of the current focus on functional foods and nutriceuticals. This omission could be explained by the different names for the same or related product produced in the different countries with research published in the local languages, mainly in Spanish and Japanese. These publications sometime lack the English abstracts therefore impeding the transmission of valid scientific information, contributing to a lack of awareness and an image problem.
Even with the identity problem, 46 academic publications were identified to support the various benefits of consuming non-centrifugal sugar. The highest frequency of reports were dedicated to immunological effects (26%), followed by anti-toxicity and cytoprotective effects (22%), anti-carcinogenic effects (15%) and diabetes and hypertension effects (11%).
The identity problem of the NCS Panela is compounded by the use of other names in each of the many countries where sugarcane is grown, failing to internationalize one common name for NCS such as Panela: at least 19 different names for NCS Panela have been found. One example of the identity problem is the recent wrangle in the USA over "evaporated cane juice", which is NCS Panela offered under a new, attractive, marketable product name.
Panela consumption is not a new phenomenon; Panela has been consumed for generations in the sugarcane producing countries as a staple food to meet dietary needs for carbohydrates, minerals and vitamins as a sweetening agent. Historically the consumption of Panela, in block form, has been for the low income sector, with consumption perceived as a poverty good. The effects of urbanization combined with the perception of an inferior good, combined with poor Panela quality (foreign matter presence) and presentation (i.e lack of easy to dissolve high quality products) have impacted the demand structure of traditional block Panela. Panela consumption diminished as household incomes rose, in both urban and rural areas. Given the economic characteristic of Panela being an elastic good (13), an increase in price results in the substitution for the closest substitute, that being refined centrifugal sugar. The economies of scale for large-scale industrial refineries have negatively impacted the consumption of Panela. Even so, Panela consumption for Colombia, the second major world producer of Panela was, according to FAOSTAT, 11.04 kg/capita/year for the period 2005-2009.
Consumption of the NCS Panela in more innovative presentations for quick usage has been increasing in the natural foods sector where the health benefits are appreciated and sought after. There is potential for increased growth. The natural foods

market is a budding market for organic certified granulated Panela and small cubed Panela for direct consumption as a healthy alternative to centrifugal sugar albeit still marked by the lack of awareness, identity problem, and lack of scientific information concerning the health advantages for Panela.
Traditional conventional Panela in block form (250g, 500g, 1000g or 2000g) has been consumed as a sweetener for generations in sugarcane producing countries the world over. Traditionally Panela has been produced by small peasant producers in developing countries in "trapiches" or artisanal sugarcane mills in a labour intensive open vat processing system that takes approximately 12 hours for blocked panela production. In Colombia, Panela has traditionally been consumed as "Agua de Panela" a hot drink for either treating common colds or for warming one up on a cold day or as a refreshing cold drink in addition to its use as a sweetener in many local dishes. Granulated Panela was introduced in Latin America approximately 20 years ago for quicker consumer use. Popularity for quicker use Panela has increased steadily over time.
The newly innovated industrially produced low humidity fine-grained powdered Panela produced in Colombia is considered the evolution of the Panela. This Panela is higher in quality standards and has a much finer granulometry and is characterized as free-flowing, with high solubility. It is important to note that the traditional block and granulated Panela for industrial use may require additional innovation in order to meet the international food and beverage standards to fulfil microbiological, granulometry, sanitary conditions uniform colour and humidity levels that affect the shelf-life of Panela and of the product it sweetens. The new industrially produced, low humidity, fine granulometry Panela currently offered in Colombia does classify as a nutriceutical and functional food and is gaining recognition as an alternative natural nutritional sweetener for industrial applications as an input and as a final product. This patented, low-humidity, fine grained Panela is now the input for a vast array of industrially produced foods in Colombia including powdered pudding mixes, cocoa and chocolate products, colas, milk and yogurt products, ready-mix beverages, and lactose nutritional supplements targeting a wide span of consumers, from the most disadvantaged popular sector to the higher gourmet sector. Panela use as a sweetener in the Food and Beverage industry is also slowly gaining acceptance in international markets. Panela is not only found in ethnic stores but is increasingly more common to find in cereals and baby products (Germany, Switzerland), weight management bars (Israel) and beverages in the European, Japanese and US markets. More than 46 Panela beverages alone are produced or commercialized in the US. International trade information for Panela (HS 170113) supports the trend of using Panela as an alternative natural nutritional sweetener.

The colour of Panela could be a deterrent for some industrial use given the darker appearance compared to white refined centrifugal sugar. It is important to note that Panela colour is determined by sugarcane variety and soil characteristics. Panela colour is not determined according to ICUMSA numbering scales, since results can top 20,000 IUs, but rather by the intensities of the light brown hues where Light Golden Brown is one organoleptic classification.
The challenge is to increase awareness for a wider international acceptance of Panela as *the* natural nutritional sweetener. The Food and Beverage industry is encouraged to seek Panela as an alternative sweetening ingredient for new product development or for existing products including applications in: water, milk, whey, cola, fruit and alcoholic based drinks, confectionary goods (gums, candies, and chocolates), puddings, cakes, energy bars, cereals, snacks, etc – anywhere a sweetener is required, better yet where a natural nutritional sweetener is required.

Is there any toxicity or hazard issue to mention about Non-Centrifugal Sugar?

Inadequately processed Panela can contain relatively high levels of acrylamide, a suspected carcinogen which has been a recent global food health issue. While there is no legal boundary value for acrylamide for foods and beverages, a signal value for acrylamide of 1000 µg/kg food in Germany has been issued by the German Consumer Protection and Food Safety Authority (14). Low acrylamide Panela is easy to achieve with Best Practice Management and innovative production system technology (i.e. closed systems). For Panela, acrylamide values measured below 800 µg/kg have been used as a benchmark. If this value is exceeded, Food & Beverage companies should enter into dialog with the producer to assess where the high value could come from (i.e. high process temperatures or the incorrect use of flocculants). Quality assurance testing of acrylamide by an internationally recognized laboratory (15) should be conducted on all Panela in order to quantify and compare to accepted levels.
When deciding for Panela as an alternative sweetener in the Food and Beverage industry, it is imperative to select one in which fulfils all of the International food and beverage norms analysed as per the Baumgart methods (16) for the non-presence of foreign matter, heavy-metals (17), humidity levels, granulometry, residual pesticides, package migration and other microbiological aspects such as aerobic mesophilic bacteria, Enterobacteria (incl. E. coli, Salmonella), Yeasts, Moulds (Wallemia sebi), acid-tolerant bacteria, thermophile aerobic Spores-formers, Thermophilic acid-producing Spores-formers, thermophilic anaerobe H2-producing spores-formers, thermophilic anaerobe H2S-producing spores-formers, Listeria monocytogenes, Salmonella, Shigella, Listeria and Staphylococcus.

Describe the potential benefits of Non-Centrifugal Sugar production and manufacturing regarding social responsibility, sustainability or benefits to the community?

NCS Panela production and processing have several directly positive benefits regarding corporate responsibility sustainability and benefit to the community. These benefits have a positive impact on food security, climate, sustainability, and rural development and are important points for the Food and Beverage industry to take into consideration.
The utilization of sugarcane for Panela production and not for first generation bio-fuel production (ethanol) does not contribute to further increasing volatile food prices or for larger-sale land acquisitions. Sugarcane production for Panela production therefore contributes to food security. Sugarcane production for Panela has a low environmental footprint compared to refined centrifugal sugar.

A comparison of the CO_2 emissions (18) has shown that Paraguayan organic NCS Panela emits 20% less CO_2 than conventional refined centrifugal Colombian sugarcane production, and emits 40% less CO_2 than organic sugar beet production in Europe. The reduced CO_2 emissions result from both the sugarcane production and processing methods.

The pressed and milled sugarcane ("bagazo") used obtained in the production of panela is used as thermal energy for production, not only lowering thermal energy costs but also enabling the production process to be CO_2 neutral. Panela production is considered water neutral given the use of rainwater in the cultivation and production process.

Production methods of Sugarcane production for NCS Panela tend to be organic, beginning with the use of GMO free sugarcane cultivars. Biological control for pest management and application of environmental organisms in the post-harvest process eliminates the practice of post-harvest burning, contributing to proper soil management *and* creating a sustainable production system facilitating to organic certification.

It should be noted that maritime shipment of full container loads of Panela (> 10MT) not only lowers the input and public price for Panela, but also provides a lower environmental impact than air transport shipments. Additionally, industry sponsored Carbon Off-Set Reforestation projects will decrease the CO_2 footprints created by Panela transportation directly benefiting the local communities involved in Panela production contributing further to sustainability.

Sustainability is certainly an issue for Panela used in industrial use. Given the significance and growth of sugarcane and all its derived products, there is a growing need world-wide to identify and adopt sustainable sugarcane production and processing practices as they incorporate economic, financial, environmental and social dimensions and reflect good industry practices for the sugarcane sector in order to provide safe and secure employment as well as the protection of the environment. Unfortunately world-wide sugarcane production is marked by the use of child and/or slave labour in certain countries. The Better Sugarcane Initiative Ltd ('BONSUCRO'), the Roundtable for Sustainable Sugarcane production confirms the commitment of setting a global precedent around corporate social responsibility and global sustainability by establishing a necessary standard for the sugarcane value chain. Membership as well as certification in BONSUCRO provides many opportunities to be a part of the driving force of the sugarcane industry by focusing on the economic, social and environmental factors involved. Currently BONSUCRO is analysing the implementation of a new category for NCS Panela producers given the recent awareness of the importance of NCS Panela within the sugarcane derivative industry. One Colombian sugarcane producer for Panela production has recently obtained membership in BONSUCRO.

Characterized as labour intensive and a vital contribution to the economic development of the developing countries where it is produced, Panela production is a viable strategy for diversifying incomes in rural areas. Panela is one of the most traditional agro industries in Latin America. In Colombia alone, approximately 240,000 hectares are dedicated to sugarcane production for Panela production and is considered a major income-generating source for more than 70,000 families, with 80% production occurring on farms with less than 5 hectares in more than 350 municipalities. The Panela sector generates more than 1,750,000 direct and indirect jobs of which 120,000 are subsistence farmers. International market acceptance of Panela as a sweetening agent in the nutritional, nutriceutical and nutricosmetic industries would impulse a major agricultural sector. Innovation through the production of Panela through closed system production systems in coordination with strategic alliances to the industry would provide a mass stimulus for the rural development in Colombia.

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15. Only two labs were found internationally for acrylamide testing, one of which is Wessling AG (Switzerland).
16. Chapter VII
17. Due to the use of contaminated water in the cultivation process
18. Measured in CO_2/Kg production

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China Food Additives Journal
Rm. 1402, Tower 3, Vantone, No. 6A,
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Tel: +86-10-5979 5833 Fax:+ 86-10-5907 1335, 5907 1336
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