

THE INFLUENCE OF NUTRITIONAL ASPECTS IN BRAZILIAN FRESH FRUIT AND VEGETABLE CHAIN COORDINATION

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ABSTRACT

The Brazilian market of fresh fruits and vegetables (FFV) is changing very fast due to the development of new technologies, which allow better and longer conservation of these highly perishable products, and the increasing number of attributes required by the urban consumer. Nowadays, not only appearance and price are important, but the combination of freshness, good taste and high quality at medium prices with additional attributes as practicality and nutritional content of the food, considered essential to the maintenance of health, are the main consumer's choice determinants. The practicality and knowledge of nutritional recommendations, which indicates benefits to the consumption of large amounts of FFV products, are influencing the consumers' preferences and changing the population's daily diet, as well as the management of this chain in Brazil.

The paper is organized as follows: the first part describes the current system of FFV commercialization in Brazil. The second part aims to demonstrate the need of daily consumption of FFV and justify the nutritional recommendations of eating large amounts of vegetables, through the discussion of the nutritional characteristics of these foods: the high concentrations of important vitamins and minerals, the presence of fiber and its importance to the body functioning and the discovery of phytochemicals and its beneficial effects in the maintenance of good health. Some examples of business strategies to assure these specific attributes of quality are presented in the third part. It will focus on the strategies adopted to obtain the consumer preference that use the nutritional aspects of FFV products to influence the consumer purchase decision. The paper concludes with some speculation on the evolution of the Brazilian chain for fresh produce.

KEY WORDS : Fresh Fruits and Vegetables, Consumer, Nutrition.

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1. INTRODUCTION

Agriculture is the major productive activity worldwide, employing larger number of workers than the sum of all the other occupations existent (International Food Information Council - IFIC, 1998). Meanwhile, among approximately 250.000 known vegetal species, only 20 species are grown with purpose of food production (Barber, 1990).

**TABLE 1 : Number of Countries According to the Consumption Level of Fruits and Vegetables
in Different Regions of the World.**

No.Countries by Daily Per Capita Consumption (Total Countries)	Europe (27)	North America (2)	Latin America (26)	Near East (15)	Far East (23)	Africa (38)	Oceania (2)
Vegetables							
<i>Range (g)</i>	27 - 466	213 - 318	35 - 265	30 - 381	10 - 362	5 - 146	192 - 234
< 100g	4	-	21	5	9	34	-
100g - 200g	11	-	3	4	11	4	1
200g - 300g	7	1	2	4	2	-	1
300g - 400g	4	1	-	2	1	-	-
> 400g	1	-	-	-	-	-	-
Fruits							
<i>Range (g)</i>	58 - 397	230 - 276	69 - 356	49 - 410	6 - 186	11 - 180	211 - 275
< 100g	6	-	5	4	14	31	-
100g - 200g	9	-	14	2	9	5	-
200g - 300g	9	2	5	3	-	-	2
300g - 400g	2	-	2	4	-	-	-
> 400g	1	-	-	2	-	-	-
Pulses, Nuts and Seeds							
<i>Range (g)</i>	4 - 90	12 - 22	6 - 81	13 - 36	11 - 100	8 - 140	10 - 13
< 20g	17	1	4	5	8	7	2
20g - 40g	7	1	14	10	8	16	-
40g - 60g	2	-	4	-	4	6	-
> 60g	1	-	4	-	2	9	-
Cereals							
<i>Range (g)</i>	157 - 534	176 - 180	156 - 379	270 - 565	323 - 572	54 - 544	212 - 216
< 200g	6	2	4	-	-	10	-
200g - 300g	9	-	15	2	-	6	2
300g - 400g	7	-	7	7	10	11	-
400g - 500g	3	-	-	4	11	9	-
> 500g	2	-	-	2	2	2	-

Source : Pekkarinev (1975) - Data taken from the Food and Agriculture Organization - FAO (1972).

Brazil is one of the major fruit and vegetable producers, producing mainly tropical fruits to exportation; and also one of the major importers of fruits like apples, pears, grapes and plums. In terms of consumption, however, Brazil is known only due to the high *per*

capita consumption of pulses, as indicated by Pekkarinev (1975), and presenting later a declining tendency in *per capita* consumption of all vegetable foods, according to the Brazilian Institute of Geography and Statistics - IBGE (1975, 1988 and 1996). In the international scenario, similarly to the Brazilian situation, only few countries are characterized by high level of daily *per capita* consumption of fruits and vegetables in the habitual diet, as indicated in the Table 1.

The communication of nutritional advantages and beneficial effects to health due to the daily consumption of significant amounts of fruits and vegetables became an efficient tool in the battle against the nutritional deficiencies and low consumption of nutritionally important foods in the habitual diet.

FIGURE 1 : Food Guide Pyramid.



Source : U.S.Department of Agriculture (1992).

Foods of plant sources are nutritionally essential due to its high contents of vitamins, minerals and dietary fiber; being recommended the daily consumption of large quantities of fruits (2 to 4 portions) and vegetables (3 to 5 portions) to ensure a healthy and balanced diet, according to the Food Guide Pyramid (Figure 1) developed by the U.S.Department of Agriculture in 1992. Bourne (1977) argues that the main nutritional deficiencies prevalent

in the populations of developing countries, specially the vitamin-mineral deficiencies, could be simply eliminated by an increase in the amount of fruits and vegetables consumed in the habitual diet (Caixeta-Filho, 1999).

Highlights on the role of plant foods as the unique source of dietary fiber, once foods of animal origin do not contain this nutrient, essential to the maintenance of gastrointestinal tract regular functioning, prevention of constipation and reduction of diseases development probability, as cancer, cardiovascular diseases, etc. (Meister, 1996).

Recently, scientists have investigated the effects of biologically active substances naturally occurring in vegetables, named phytochemicals, and found results that associate reduction of incidence of certain diseases to the presence of phytochemical compounds in the diet. The introduction of phytochemicals concept, beyond the emphasis on the relevance of plant foods in the diet, promotes the discussion on the suitability of the actual consumption of fruits and vegetables by the worldwide population.

On other hand, several international retailers have entered in Brazil through mergers and acquisitions and spurred the modernization of Brazilian retailers. Heavier competition has depressed supermarkets' operational margins and the FFV department has become a factor of differentiation and margin recovery. However, its management is particularly complex due to the absence of standards, highly variable quality and precarious adoption of the cold chain. The information system is deficient and many profit opportunities are taken by intermediaries. Thus, the price risk is very high and the transactions between agents are marked by extreme uncertainty and measurement problems. New governance structures have emerged in response to the new behavioral characteristics of the consumer and new competition characteristics of this market.

The paper aims to evaluate the impact of the communication of nutritional information over the production, commercialization and distribution of foods derived from plants in Brazil; and analyse the relevance of high daily consumption of fruits and vegetables, as food resources primarily purveyors of dietary fiber and phytochemical substances, presenting risks, benefits and recommendations related to the consumption of these compounds. It will examine how these aspects of the FFV products have influenced retailers, wholesalers and fresh vegetable industries, in order to use the quality as a differential competitive factor.

2. THEORETICAL CONSIDERATIONS

2.1. DIETARY FIBER CONTENT

The composition of dietary fiber is highly variable, depending on the source. The generic definition of dietary fiber includes a large number of chemical substances that cannot be totally digested due to the absence of the necessary enzymes in the human gastrointestinal tract. There are two distinct types of dietary fiber, according to its water solubility and cell function : insoluble/structural fiber and soluble/non-structural fiber (Davidson and McDonald, 1998; Gurr and Asp, 1994; Lajolo et al., 1991).

The complex structure of fiber, derived from the mixture of several different substances, is one major difficulty in the study of dietary fiber and its effects in the human organism; and the analysis of the compounds disaggregated is quite inaccurate (Gurr and Asp, 1994; Lajolo et al., 1991).

The main effect of fiber in the diet is the prevention of constipation due to the increase in the stool bulk, but the physiological effects associated to the consumption of dietary fiber with the diet include increase in salivate, retard in nutrients absorption, higher acidity, decrease in transit time of stool and flatulence. The increase in the stool bulk is essentially caused by the dietary fiber's high capacity of water absorption, reaching 4 to 6 times the weight of dry dietary fiber consumed (Lajolo et al., 1991; Meister, 1996).

There are evidences that the daily consumption of significative amounts of dietary fiber in the diet acts preventing diseases like breast and colon cancer, coronary heart disease and diabetes (Meister, 1996).

Although the mechanisms of the beneficial effects of dietary fiber consumption are only slightly known, there are some hypothesis : the increase in the speed of stool bulk elimination promotes a reduction in the exposure time of gastrointestinal tissues to carcinogenic or mutagenic substances, minimizing the possibility of absorption; the high bounding potential of dietary fiber to several types of compounds, including harmful substances, obstructing the gastrointestinal absorption process; or, alternatively, the presence of potentially protective substances formed during the fiber fermentation process in the gastrointestinal tract (Davidson and McDonald, 1998; Meister, 1996).

TABLE 2 : Dietary Fiber Content in Foods.

Food	Portion Size	Dietary Fiber (g)		
		Total	Soluble	Insoluble
<i>Fruits</i>				
Apple (peeled, large)	1 unit	2,6	0,3	2,3
Apple (unpeeled, large)	1 unit	3,6	0,3	3,3
Banana	1 unit	2,9	0,8	2,1
Grapefruit (sections)	½ cup	0,5	0,1	0,4
Grapefruit (with membrane)	½ unit	2,5	0,5	2,0
<i>Vegetables</i>				
Broccoli (cooked)	½ cup	2,7	0,3	2,4
Carrot (raw)	1 unit	2,1	0,2	1,9
Corn (cooked, whole kernel)	½ cup	1,7	0,1	1,6
Potato (baked, with skin)	1 unit	4,9	3,7	1,2
Tomato (canned)	½ cup	0,9	0,2	0,7
<i>Grain Products</i>				
Bread (white)	1 slice	0,7	0,2	0,5
Cereal (40% bran flakes)	1 cup	7,6	0,8	6,8
Cereal (corn flakes)	1 cup	1,1	0,1	1,0
Cereal (oat bran, uncooked)	⅓ cup	4,8	1,8	3,0
Cereal (oat meal, cooked)	1 cup	4,4	1,7	2,7
Macaroni (cooked)	1 cup	2,5	0,3	2,2
<i>Legumes and Nuts</i>				
Almonds (with skin)	15 units	5,6	0,6	5,0
Green Peas (canned)	½ cup	2,8	0,3	2,5
Kidney Beans (canned)	½ cup	6,6	1,5	5,1
Lima Beans (canned)	½ cup	3,6	0,4	3,2
Peanut Butter	1 tbsp	1,1	0,1	1,0
Peanuts (roasted in shell)	10 units	1,9	0,1	1,8

Source : Meister (1996) - Adapted from Albertson and Tobelmann (1995).

Meanwhile, there are scientists that attribute the inverse correlation between consumption of dietary fiber and incidence of diseases to the fact that diets with high levels of fiber are an indication of choice for a healthier lifestyle, less exposed to prejudicial factors such as stress, alcohol, cigarettes and, therefore, less inclined to occurrence of several types of diseases (Meister, 1996).

On the other hand, the excess of dietary fiber consumption can lead to a higher nitrogen excretion, lower absorption of iron and copper; and reduction of the bioavailability of calcium, magnesium, zinc and phosphorus; resulting in long term nutritional deficiency. Additionally, the beneficial effects due to the consumption of dietary fiber are very modest; thus, the fiber rich diet cannot be used as a substitute to traditional dietetic and/or medical treatments, only as a coadjuvant to the indicated treatment (Frølich, 1995; Meister, 1996).

The consumption of moderate quantities of dietary fiber in the diet is healthy, being recommended 20g to 35g of fiber per day to adults (American Dietetic Association, 1993). However, it's consensus that, more important than the quantity of fiber in the diet, is the quality of the diet which contains this fiber (Meister, 1996).

2.2. PRESENCE OF PHYTOCHEMICAL SUBSTANCES

Chemoprevention, defined as the deliberate introduction of selected substances in the diet for the purpose of reducing incidence of diseases, represents a new approach in food science and nutrition, with considerable social, economic and political impacts.

Phytochemicals are potentially chemopreventive biologically active substances naturally occurring in plants, being found in all parts of plants : wood, bark, stems, pods, leaves, fruits, roots, flowers, pollen and seeds. The presence of several phytochemical substances mixed together in foods is the major limitation to its study and identification of the mechanism of action (Andlauer and Fürst, 1998).

A main group of phytochemicals naturally occurring in foods are the phenolic compounds, also known as polyphenols, plant metabolites with important physiological functions in the vegetal structure. There are approximately 8.000 identified phenolic compounds, synthesized only by plants. Phenolic compounds are responsible for the color, flavour and taste of the plant (Andlauer and Fürst, 1998; Bravo, 1998; Chung et al., 1998).

Polyphenols are characterized by its high reactivity to amino acids, carbohydrates, minerals and vitamins; and have anti-inflammatory, antioxidative, antidiarrhoeal, blood vessel dilator, antiviral and antibacterial activity; beyond therapeutic application in the treatment of hypertension, high cholesterol levels and allergies; and a potential, but still questionable, anticarcinogenic and antimutagenic action (Bravo, 1998; Chung et al., 1998).

Other important group of phytochemicals is composed by substances with reduced hormonal activity naturally occurring in several plant foods. Its antioxidative and anticarcinogenic effects are primarily due to its weak hormonal activity, which allows bounding with hormonal receptors and, therefore, blocks the transportation of more potent and reactive hormonal substances, potentially starters of oxidative processes and carcinoma (Andlauer and Fürst, 1998).

A third group of phytochemicals is the group of nutritive antioxidants, found in fruits, grains and vegetables. The main subgroup of nutritive antioxidants are the carotenoids, which includes a large number of chemical compounds (more than 1.600 identified substances). Its main function in the vegetal structure is natural pigmentation, that acts as protection against the chlorophyll photodegradation through the absorption of light (Rodriguez-Amaya, 1997).

The antioxidative activity of phytochemicals is highly variable, acting with one or more of the following functions : free radical scavengers, reducing agents, potential complexers of prooxidant metals, and quenchers of the formation of singlet-oxygen (Andlauer and Fürst, 1998).

2.3. MARKETS AND HYBRID GOVERNANCE STRUCTURES

Transaction Cost Economics provides the analytical framework to the better understanding of FFV market coordination, since it may embrace a diversity of complex arrangements. According to Brousseau and Codron (1997), the major attributes of transactions involving fresh produce are temporal and local specificity, due to its high perishability and low value/weight ratio. Several economic agents are involved in supplying big cities with FFV. In order to improve the quality of fresh produce, especially the shelf life aspect and microbiological control, investments must be made by each of these agents, and their performance depends on a well-coordinated action.

In order to improve the quality of fresh produce, especially its shelf life, aspect, and microbiological control, investments must be made by each of economic agents involved in supplying FFV products, and their performance depends on a well-coordinated action. Thus, the seller's risk may be extremely high. However, without a system that can trace back through the chain, it is difficult to assign responsibility for damages to the product and

there is a tendency to transfer an undue share of market risk from operators to growers through lower prices or return of shipments. Hybrid contracts improve quality and quantity control, but the market power imbalance may persist, and the distribution conflict may preclude net benefits, which could be collected by cooperative behavior.

Market governance still works for most sourcing transactions. The main advantage of physical markets is the ability to gather many buyers and sellers in one location at a time. These markets are efficient in matching supply and demand volumes, but broad price variations may be observed. In addition, physical transactions often damage the quality of produce in terms of aspect, shelf life, and contamination.

Generally it could be argued that strictly coordinated systems would emerge when the quality standard is much stricter than the general requirements which, together with perishability, results in high asset specificity commanding hybrid governance structures or vertical integration.

3. LOOKING FOR ALTERNATIVE COORDINATION SYSTEMS³

Many surveys have documented consumers' primary attitudes about nutrition, but few have examined the motivation behind consumer food choices. In an effort to better understand such motivation, the International Food Information Council (IFIC) and The American Dietetic Association (ADA) commissioned the Gallup Organization to find out how consumers are really making food choices (IFIC, 1994).

Americans are considerably knowledgeable about basic nutrition and its relation to health. An overwhelming majority (95%) believe that balance, variety and moderation are the keys to healthy eating. Over 80% of adults are concerned about the effect of diet on future health. The concern tends to be higher among women, adults 31-49 years of age and college-educated. Males, younger adults (18-30 years old) and individuals with less than high school education tend to be less concerned (IFIC, 1994).

The majority report increasing consumption of fiber (65%) and oat bran (51%) due to health concerns. But when asked if they are increasing anything else in the diet, only 8% report eating more vegetables and 6% report consuming more fruits or fruit juices. Despite the high level of knowledge, in the selection of foods, many individuals fail to apply

³ Based on interviews with retailers and wholesalers.

nutritional knowledge. More than 60% report selecting foods based on "good" or "bad" perceptions, rather than the fundamentals of balance, variety and moderation (IFIC, 1994).

TABLE 3 : Influence of Nutritional Information on Consumers' Choice.

Concern About Diet Affecting Future Health	
Very Concerned	46%
Fairly Concerned	37%
Not Too Concerned	12%
Not At All Concerned	5%
Items Increasing in Diet Due to Health Concerns (Aided)	
Fiber	65%
Oat Bran	51%
Calcium	49%
Vitamins	48%
Olive Oil	24%
Fish Oil	15%
Don't Know	13%
Other Items Increasing in Diet Due to Health Concerns (Unaided)	
Vegetables	8%
Fruit/Fruit Juice	6%
Fish	3%
Chicken	2%

Source : IFIC (1994).

Farina and Machado (1999) show that the urban consumer are becoming more demanding with respect to prices and quality. Supermarkets and grocery stores adopted new commercialization strategies, in order to be more attractive to the new exigencies of consumers.

Most of the retailers started printing folders that bring nutritional information, recipes and detailed description of the products' attributes (origin, planting techniques, presence or absence of additives, transportation, storage, etc.). Other important strategy is the creation of their own quality labels, which guarantee to the consumer best flavour, taste, safety, convenience, quality of origin and product's traceability. A third commercialization strategy commonly adopted nowadays is the maintenance of a trained team for products' demonstrative sessions, where nutritional value and quality attributes are presented to the

consumer by specialist sellers and the consumer is allowed to experience a free sample of the product.

CONCLUSION

The recommendations of fruits and vegetables daily consumption intend primarily to provide the necessary ingestion of nutrients through a diversified and balanced diet, in order to optimize the organism functioning and health maintenance of the individuals. Recently, results of several researches on the therapeutic effects of phytochemical substances have emphasized the additional benefits of the habitual plant foods consumption in large amounts and variety.

Meanwhile, the *per capita* consumption of fruits and vegetables is far from the ideal in almost all countries. Dietary habits and lifestyles prevalent worldwide privilege the consumption of prepared foods in fast meals, mainly composed by carbohydrates and lipids, in order to salient flavour and taste of the food, and with low nutritive value in terms of vitamins, minerals and fiber. The spread of nutritional informations tend to revert this situation, a new worldwide trend confirmed by the survey commissioned by ADA and IFIC (1994).

Recently, researches have identified that retailers are modifying their competitive strategies, highlighting the beneficial effects of fruits and vegetables in the habitual diet and offering higher quality and readiness in their products in order to capture the preference of the new consumers, highly worried with quality, health and nutrition.

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