



Product design for a functional non-alcoholic drink

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ABSTRACT

Product design is the procedure by which customer needs are translated into commercial products. The non-alcoholic drink sector has seen a tremendous growth of new products in recent times. Many of the new innovations include light versions of juices with lower calorie and carbohydrate content and an increase in the variety of juices that are used. In recent trends, consumers seek beverages or drinks that help improve on their health status due to the increasing rate of diseases and sicknesses hence most non-alcoholic drinks on the market have an additional value of health benefits. The aim of this work was to design a non-alcoholic drink product with functional properties to satisfy customer needs, ensuring that all safety, environmental and industrial regulations were taken into consideration. Customer needs in relation to functional fruit drink was identified through survey. These needs were translated into product specifications and various product concepts generated and the best selected using a selection matrix. From assessing the needs of customers and with the help of the selection matrix, prekese functional non-alcoholic drink was chosen as a better functional fruit drink relative to most drinks on the market. The prekese functional non-alcoholic drink had an antioxidant capacity of 24–28 $\mu\text{mol Fe}^{2+}/\text{L}$ which is greater than that of the benchmark and most drinks on the local market.

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1. Introduction

Product design is the procedure by which customer needs are translated into commercial products (Cussler and Moggridge, 2001). The soft drink sector has seen a tremendous growth of new products in recent times. Many of the new innovations include light versions of juices with lower calorie and carbohydrate content and an increase in the variety of juices that are used. More exotic flavors (e.g., orange, passion, and pomegranate fruit) have become common in juice blends. New fruit smoothies are currently entering the market as a healthy, nutritious complement or alternative to snacks. Fortification with vitamins and minerals is also being used to attract consumers with specific health concerns. Soft drinks in this product line are aimed at people at various ages. Orange juices for heart health and some varieties with antioxidants for increased immunity are some of the new product examples reaching the market. Manufacturers have also focused on using health-oriented product or brand names to promote health benefits associated with soft drinks. Consumers' awareness towards the

association between food and health has flare-up interest in “healthy foods” in recent years (Shah and Prajapati, 2013). Thus, the food industry is targeting for the development of more healthy foods due to consumers' awareness towards the relationship between food and health and their demands of decreasing the use of chemical preservatives (Thakur and Sharma, 2017).

The term “functional food” was first used in Japan, in the 1980s, for food products fortified with special constituents that possess advantageous physiological effects (Hardy, 2000; Kwak and Jukes, 2001). The bioactive compounds have received increasing attention due to their potential role in the prevention and treatment of human diseases through a variety of mechanisms, mainly related to gastrointestinal health and prevention of chronic degenerative diseases (ADA, 2008; Saura-Calixto and Goñi, 2006; Chong et al., 2010; Sun-Waterhouse, 2011). Due to these health benefits, there is a growing demand for functional fruit and ingredients by consumers (Figueroa et al., 2005). Among the functional compounds, several recent researches have focused on the physiological effects resulting from the human consumption of a wide variety of dietary fibers. Functional foods have the potency to improve the general conditions of the body (e.g. pre- and probiotics), decrease the risk of some diseases (e.g. cholesterol-lowering products), and could also be used for curing some illnesses. It was recognized that there is a

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demand for these products as different demographical studies revealed that the medical service of the aging population is rather expensive (Menrad, 2003).

Fruits and vegetables are sources of important nutrients, such as C-vitamins and folic acid, which is a kind of B-vitamin. They also contain minerals such as potassium and magnesium, as well as food fibers. Some fruits also carry carotene, which is converted to A-vitamins in the body, or flavonoids, which work as antioxidants. Antioxidants are substances that take care of free radicals inside the body. Free radicals are harmful molecules that might lead to infections, cancer etcetera (National Food Administration, 2011). During food processing, the nutrient content is changed in different ways. Vitamins are sensitive to temperature, time, oxygen, light, pH etcetera. Metals such as iron or copper can act as catalysts if used during food preparation. The most sensitive of all vitamins is the C-vitamin; it is easily destroyed during processing and storage. Apart from the conditions mentioned above, C-vitamins are also unstable when it comes to enzymes and salt or sugar concentration. However, it is stable in acid condition, which for example the A-vitamin is not. When fruit and vegetables are processed, or for example peeled, minerals might also be lost (Bergström, 1994).

In the last decades consumer demands in the field of food production has changed considerably. Consumers increasingly believe that foods contribute directly to their health (Young, 2000). In recent times, foods are not intended to only satisfy hunger and to provide necessary nutrients for humans but also to prevent nutrition-related diseases and improve physical and mental well-being of the consumers (Menrad, 2003; Roberfroid, 2000b). In this regard, functional foods play a vital role. The increasing demand on such foods can be explained by the increasing cost of healthcare, the steady increase in life expectancy, and the desire of older people for improved quality of their later years (Kotilainen et al., 2006; Roberfroid, 2000a, 2000b). In view of these, consumer demand for safe, functional and fresh product, such as fruit drink, has been increasing as a consequence of the research for a healthier life. Many substances in fruit, especially fruits such as C-vitamin, vitamin E, beta-carotene, and phenolic compounds are excellent antioxidants that are able to stabilize free radicals. The importance of these antioxidants in the maintenance of health and prevention of severe pathologies, including different kinds of cancer, cardiovascular and neurological diseases, and aging related disorders has been described by several workers (Lim et al., 2007). The beneficial properties of fruits have thus been widely investigated including *Tetrapleura tetraptera*. Among the main classes of natural antioxidants in fruits and beverages are polyphenolic compounds. Thus, in recent trends, consumers seek beverages or drinks that help improve on their health status due to the increasing rate of diseases and sicknesses, hence most fruit drinks on the market have an additional value of health benefits. Thus, in the current wave of concern about functional fruit drinks, considerable effort is being put into sources of “green” fruit, which has high antioxidant activity and with less enzymic browning.

Africa has been found to be a treasure store of plants rich in medicinal and nutritional value. Some known examples include blackcurrants, blackberries, cranberries, pomegranates, and Prekese (*Tetrapleura tetraptera*) among the lot found in the Africa continent. *Tetrapleura tetraptera* locally known in Ghana as “Prekese” is also rich in natural sugar an indication that functional fruit drinks from prekese will contain very little or no artificial sugar, hence may be ideal for diabetic patients. In Ghana, prekese has been used to flavor soft drinks which has been approved by the Food and Drugs Board, and is marketed to reduce hypertension, decrease the severity of asthma attacks, and promote blood flow (TFNet, 2011).

Tetrapleura tetraptera is a species of flowering plant in the pea family native to Africa (Steenstofm, 1988). The wealth of Prekese as a medicinal plant has been embedded in local and traditional Ghanaian and Nigerian homes and neighboring parts of Africa for centuries. The curative properties of the plant and its nice fragrance have made it a very common ingredient in most homes in Ghana (Aladesanmi, 2007). The fruit is conventionally used as spice and as a natural multivitamins in cooking most Ghanaian soups. The prekese fruit has dark brown, four winged pods 12–25 × 3.5–6.5 cm and it is generally found in the lowland forest of tropical Africa. The fruit consists of a fleshy pulp with small, brownish-black seeds and a unique scent only associated with the prekese fruit which most Ghanaians like and use as spice (Aladesanmi, 2007). Most Ghanaians now prefer organic fruit drinks to non-fruit soft drinks because of the natural health benefits of the organic fruits over the non-fruits which comes with its side effects. In addressing this need, the work sought to select an indigenous fruit that has considerable amount of antioxidants to produce such a functional fruit drink. Prekese has quite significant amount of natural sugar and has inherent preservative properties and anti-hypertensive properties associated with its high antioxidant properties (TFNet, 2011; Badu et al., 2012). The objective of this work was to design and produce a functional fruit drink in order to address the empirical need of consumers for such drinks.

2. Methodology

2.1. Consumer needs assessment

Consumer needs for juice and other non-alcoholic beverages were assessed through interviews. The survey was conducted in three randomly selected communities each in Kumasi (Amakom, Adum and Tafo) and Sunyani (Estate, Area 2 and Penkwase) to determine the consumption patterns of non-alcoholic beverages. The sample size was thirty in each community. Respondents were randomly selected, based on consent, during visits to the market, homes, schools and work places in the selected communities. A semi-structured questionnaire was used during the interviews to obtain information from customers including retailers and consumers on background characteristics of respondents, frequency of consumption, perceptions of non-alcoholic beverages consumption, desire for functional non-alcoholic beverages and to evaluate the needs they expect in juice and other non-alcoholic beverages. The needs were translated into product specifications.

2.2. Product design alternatives

In the production of functional fruit drink, several alternatives were considered. First were the type of fruit, and second was the method of production. Product design ideas to meet the product specifications were generated and the best idea selected through a selection matrix. The ideas were generated from the product development team and experts through brainstorming.

2.3. Market study

The source of supply of prekese fruits and potential demand for prekese drink were ascertained through interviews with retailers, market women and consumers.

2.4. Production process

Prekese fruits, purchased from the market were washed to get rid of dirt. The pulp was cut into smaller pieces, milled and boiled for 40 min, after which the extract was sieved through a mesh. The

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