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A REVIEW STUDY ON IMPORTANT ROLE OF CARBOHYDRATES IN THE FLAVOR

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ABSTRACT

Oral nutritional supplements ONS uses a variety of carbohydrate sources, although they are typically simple sugars that are easy to digest and absorb. Because the carbohydrate sources are simple sugars that have been "added," public health concerns about reducing "added sugars" in the diet may lead some patients to have worries. Oral nutritional supplements are frequently beneficial to patients who are malnourished or at danger of malnutrition (ONS). ONS provides a wide variety of micro- and macronutrients that may be utilized to complement a diet or offer complete nutrition. All ONS components, including carbs, are additional ingredients since ONS are specifically designed products. This may seem to contradict the increasing public health debate about the need to limit "added sugars" in the diet. Carbohydrate, on the other hand, is a necessary nutrient for human health and an important component of ONS. When ONS are recommended, assisting patients in understanding the importance of "added sugars" in ONS may be beneficial in improving compliance with dietary guidelines. In terms of taste, function, and product formulation, this viewpoint article examines the essential functions of "added sugars" in ONS.

KEYWORDS: *Carbohydrates, Nutrition, Nutrition Labelling, Sugar, Supplements.*

1. INTRODUCTION

Many malnourished or at-risk individuals may be treated with a number of dietary methods, such as texture modification, fortification, increased meal/snack frequency, and/or the use of commercially available items, referred to as oral nutritional supplements in healthcare (ONS). Both in hospitals and in the community, ONS products are rapidly being acknowledged as an important component of the entire patient treatment approach for malnutrition. Scientific data shows that using ONS may increase nutritional intake as well as clinical, economic, and other consequences[1]–[4].

This reflects the vast majority of ONS users; in most cases, these individuals do not have any complicating metabolic disorders that may affect dietary carbohydrate recommendations or consumption. ONS are designed nutrition products, thus all of the components, including the carbohydrate, are "added" to the product. When ONS are recommended, assisting patients in understanding the benefit of additional carbohydrate or sugar in ONS may be beneficial in improving compliance with dietary recommendations[5]–[7]. This article contains material that may be useful in the fields of healthcare and patient education.

1.1. Health Policy Framework for Added Sugars:

The worldwide obesity pandemic and the increase in diet-related illnesses have significantly influenced the health policy framework for added sugars. Sugar intake, especially the overconsumption of sugars added to foods and drinks, has become a hot issue in public health circles. Consumers should restrict their intake of added sugar, and producers should limit added sugar as a component in their goods, according to public health advocates.

The 2010 Dietary Guidelines for Americans (DGA) includes a suggestion to cut down on added sugar calories. The World Health Organization (WHO) and the 2015–2020 DGA went a step further in 2015, proposing that added sugars account for less than 10% of total calorie intake. The WHO has published a new conditional guideline to limit free sugar intake to less than 5% of total energy consumption. In the United States, nutrition labeling has become a policy instrument for promoting healthy eating habits. When the FDA announced its updated design for the Nutrition Facts label for packaged food on May 26, 2016, it addressed the DGA added sugar recommendation by designating a new line on the label for added sugars that would appear indented directly below "Total Sugars," a line previously labeled simply as Sugars[8]–[10].

1.2. Added Carbohydrate in ONS:

Because general ONS are classified as food, they include a Nutrition Facts label. Unlike conventional meals, however, ONS are designed and produced for individuals who are unable to fulfill their nutritional needs via a normal diet. Furthermore, although ONS products are often used to complement a diet, they may also be utilized to meet an individual's complete nutritional requirements or to bridge nutritional gaps until normal oral consumption of conventional food can resume. Patients need a source of carbohydrate in their diet, as described in more detail in this article, and with ONS, the carbohydrate is basically all added carbohydrate, since these are designed products. Dietary Reference Intakes (DRI) in the United States suggest that people eat 45 to 65 percent of their calories from carbohydrates, 10 to 35 percent from protein, and 20 to 35 percent from fat, which is comparable to the macronutrient proportions provided by ONS.

The energy and nutritional richness of ONS may be very beneficial for individuals with poor oral intake. To meet the general recommendation of 10% of calories from added sugars in the diet, significantly lowering the carbohydrate content in ONS would no longer meet the DRI's recommended level of carbohydrate in the diet, necessitating increasing the amount of protein and/or fat in the ONS beyond recommended levels to provide a product with equivalent calories. Along with concerns about not reaching required macronutrient levels, there is some evidence that ONS with a greater fat content reduce meal consumption, lowering total calorie intake.

Furthermore, the extra carbohydrate in ONS performs additional essential functions in terms of taste, function, and formulation that are not duplicated by other nutrients or components. Simple sugars' anabolic effects, which may be harmful to the general population, may be helpful to malnourished individuals and may outweigh other possible consequences, such as inflammatory ones. Novel carbohydrate-containing components are being investigated, however this article does not have space to cover this emerging technology.

*1.3.*Taste and Flavor Roles of Carbohydrate in ONS:

Taste and flavor are important influencing elements for ONS's compliance. Patients must follow healthcare professionals' product use guidelines for ONS to deliver optimum advantages. Non-compliance with ONS may be estimated in a variety of ways, depending on the situation. The findings of 46 trials including 4328 patients were combined in a systematic analysis, which showed a mean compliance rate of 78 percent (range 37–100 percent). An ONS product is only as successful as the patient's willingness to take it, and few patients are willing to forego flavor in order to use an ONS product only for its nutritional benefits.

Our sense of taste evolved as a protective mechanism for us as a species, with the fundamental taste characteristics (sweet, salty, bitter, sour, and savory or umami) enabling identification and guaranteeing consumption of safe and healthy meals. Bitter or sour tastes were thought to indicate dangerous, inedible plants or decaying, protein-rich food, whereas sweet and salty sensations were thought to indicate safe, nutrient-dense meals. The evolutionary characteristic that drove the development of our species and sustained the metabolic needs of our big brains is believed to be an inherent attraction to sweet taste and, as a result, the intake of energy-rich sugars and carbs. Because umami occurs naturally in animal meals, it signified a rich supply of protein, while salty indicated a high amount of essential mineral. The formation of our taste receptors was largely influenced by evolutionary forces, which explains why humans favor sweet and salty meals. Our dietary choices have been influenced by the learnt effects of consumed items.

When nutrients or other chemical substances attach to specific receptor cells in the mouth cavity, taste perception is activated. Taste has two primary roles: it allows us to assess foods for toxicity and nutrients, as well as it prepares the body's metabolic processes following consumption. A basic notion of whether tested meals are "acceptable" or "unacceptable" will be driven by taste perception. The multi-model experience of flavor is influenced by taste (gustation), fragrance (olfaction), and somatosensory inputs. These sensations are subsequently sent to the brain, where they are combined with additional data such as temperature, appearance (e.g., color/glossiness), shape, and sound to create a complete picture. Environment, culture, and emotion, among other factors, all affect this sensory experience. The way we think about food changes as we become older. The sense of taste is the most essential and developed of all the senses in infants. Babies have an inherent predisposition for sweet tastes, which prepares them to appreciate breast milk, which includes 40% of its energy in the form of lactose. Flavor buds continue to deteriorate as individuals age, resulting in a loss of taste.

Taste thresholds for sweetness, saltiness, and bitterness in older adults have been found to be at least 2.5 times greater (less sensitive) than in younger consumers. This shift in perception may lead to a wide range of food choices and a reduction in nutritious intake. The cephalic phase response, which prepares the body for digestion, includes the sense of taste. It increases satiety and the enjoyment of eating, which helps to regulate food selection and meal size. Taste loss is prevalent in the elderly, and it may be aggravated by illness and medications. As a consequence of the decrease in taste perception in older people, one of the most serious health risks is food anhedonia, or the inability to enjoy food, which leads to reduced food intake and, eventually, weight loss. According to studies, the average detection thresholds for older people with one or more medical problems and taking three medicines were 2.7 times higher for sweetness and 11.6 times higher for sodium salts when compared to a youthful cohort. Malnutrition and other severe health effects may result as a result of the progression of taste changes.

As previously stated, an increase in drug use with age may also impact a decrease in taste perception. In the United States, older people (those over the age of 65) use between 2.9 and 3.7 medicines on average. Over 250 frequently used medicines (often taken by older people) have been shown to have a clinical effect on taste perception. Taste dysfunction may be caused by a variety of clinical disorders, including oral illnesses, cancer, or systemic diseases of the central nervous system, endocrine system, cardiovascular system, or renal system, in addition to physiological changes associated with age and drug use. A well-designed ONS with a fairly high sweetness profile may help compensate for changes in taste perception caused by age, drug use, and/or illness. A few studies have shown that enhancing the taste of meals may enhance nutritional intake and body weight in hospital and nursing home patients, as well as healthy older people. Increasing positive hedonics like sweetness may enhance the taste profile and make eating more pleasurable.

*1.4.*Functional Roles of Carbohydrate in ONS:

There is no one naturally occurring food that provides full nutrition and can be given orally to nutritionally fragile people in tiny quantities. ONS formulations have been refined through decades of clinical research and development to address this gap. Carbohydrate, protein, and fat all play essential functions in the body and must be included in the mix. The most important function of carbohydrate in these goods is that it provides energy. Carbohydrate in the diet, such as ONS, may assist to prevent the body from utilizing endogenous sources of energy (lean body mass, adipose tissue), as well as help to restore positive energy balance after extended fasting.

1.4.1. Energy:

Dietary carbohydrate's main role in ONS and other food items is to produce energy. Carbohydrates provide about 4 kcal per gram, which is slightly more energy than protein and about half the calories per gram provided by fat. The heart, renal cortex, skeletal muscle, brain, and other neurological tissues prefer to utilize glucose for their energy requirements when they are fed. Because red blood cells (RBCs), the most common cell type in the blood, lack mitochondria, they depend only on glucose for energy metabolism (the cellular site for oxidative metabolism of fat). RBCs cannot live without a steady supply of glucose. RBCs are essential to the organism because they transport oxygen from the lungs to body tissues through the circulatory system and subsequently return carbon dioxide to the lungs for exhalation. Furthermore, cells in the renal medulla depend on glucose to fulfill their energy requirements.

1.4.2. Preventing the Utilization of Endogenous Energy Sources during Prolonged Fasting:

The post-absorptive stage, or the period after feeding after the body has absorbed the nutrients from the gut, happens hypothetically when the final nutrients of the fed state are utilized. The limited stores of glycogen (stored sugar) in the liver and skeletal muscle are exhausted during the first 12 h of the post-absorptive period. The lack of available glucose in the post-absorptive phase triggers hormonal changes that signal the switch in metabolic pathways from glycolysis (the breakdown of glucose for energy) to glycogenosis (the breakdown of glycogen), gluconeogenesis (the breakdown of non-carbohydrate substrates to form glucose), and lipolysis (the breakdown of fat) (the breakdown of fat). Thus, if carbohydrate is not accessible as a fuel source during this time, the metabolic pathways of hunger are started (as stated above), and the body is compelled to utilize endogenous sources for energy.

1.5. Formulation Roles of Carbohydrate in ONS:

Besides its physiological purpose in the body, carbohydrate also plays an essential role for the taste and palatability of ONS products. In creation of ONS formulations, one of the main roles of carbohydrate is to give sweetness to the product. In addition to this capability, carbohydrate imparts a broad variety of dietary functions. Depending on the kind of carbohydrate, it may enhance positive taste characteristics, conceal bad flavor attributes, and serve as a chemical precursor to desired flavor and color development that happens throughout production. Some carbohydrates can affect the “mouthfeel” of a food by increasing viscosity and giving textural signals sensed by the somatosensory system. The many advantages of added sugars make them a crucial formulation component. It would be nearly difficult to remove or fully replace sugars from a food composition without compromising the taste quality of the product.

1.5.1. Color and Flavor Formation:

During the typical food production step of heating, carbohydrate promotes color and taste development mainly via two non-enzymatic browning processes, caramelization and the Maillard reaction. These non-enzymatic browning processes occur throughout the production process of many ONS, resulting in positive color, fragrance, and taste alterations that are generally favored by people eating ONS. Caramelization, or the oxidation of sugar, is a process that happens during dry heating above temperatures of 110 ◦C. This procedure will produce volatile chemicals, which

contribute to desired smells, and big polymers, which are responsible for brown hues and extra texture.

In addition to caramelization, sugars may influence taste and color through the Maillard process. The Maillard reaction was named after French scientist Louis-Camille Maillard, who, in 1912, first discovered and characterized the interaction between amino acids and reducing sugars. It is widely known the Maillard reaction plays a major role in taste production during the cooking of food. Simple sugars, or carbohydrate, are broken down during heating by interacting with amino groups, either from free amino acids or proteins, to start a cascade of complicated processes that eventually leads to the production of fragrance compounds and melanoidins (brown pigments that give color in meals) (brown pigments that impart color in foods). Melanoidins vary from caramel color owing to the inclusion of amino groups in their structure. Flavor compounds created comprise many types of molecules, which are produced by fragmentation of sugars, amino acids, or intermediate compounds and give desired sweet, brown, roasted, toasted, and nutty smells. The health impacts of these components in the balance of an overall diet are starting to be well recognized. Today, more than 3500 volatiles have been discovered as Maillard reaction products including aldehydes, ketones, nitrogen, sulfur containing heterocyclic compounds, and many more.

1.6. Texture:

In liquid food items, such as ONS, sugar binds water and may enhance viscosity, give desirable mouthfeel sensations or thickness, raise boiling temperature, reduce freezing temperature, decrease the water activity, and change the behavior of proteins and starches. All sugars, mono-, di-, oligo-, and polysaccharides, include hydroxyl (OH) groups that form hydrogen bonds with water and have the ability to change the texture of meals by adding viscosity, thickness and "mouthfeel" characteristics. In the absence of additional thickening agents, the viscosity of the liquid meal is related to the number of hydroxyl groups in the mix, and thus, it is proportional to the quantity of carbohydrate in the product. For texture, carbohydrate is a wonderful natural component that contributes to a variety of activities that would need many synthetic chemicals to accomplish the same job in food product compositions.

2. DISCUSSION

ONS are intended for individuals who are unable to fulfill their nutritional needs via an oral diet alone. These items are available for clinical usage as ready-made, nutrient-dense liquids or powders. In the ONS product category, some general products are used to help meet the nutritional needs of patients with various medical conditions (e.g., malnutrition and frailty), whereas other ONS are designed for very specific conditions (e.g., critical care) or disease states (e.g., diabetes and renal disease) (e.g., diabetes and renal disease). Not all ONS products are suitable for every patient. The multidisciplinary medical team, including dietitians, must work together to identify the right product based on the unique requirements of the patient. In this article, we concentrate on the general kind of ONS that are used by patients who require additional calories, with a balanced mix of protein, fat, and carbohydrate, to restore their at-risk or malnourished state as soon as feasible.

3. CONCLUSION

A health policy framework focusing on decreasing added sugars in the general population does not translate successfully for the majority of at-risk or malnourished patients who require calories in a mix of protein, fat, and carbohydrate from ONS products. Added carbohydrate, or sugar, has essential functions within ONS in terms of taste, function, and formulation, which cannot be duplicated by other nutrients or components. Sugar is a key component that provides favorable

sensory characteristics to ONS by adding desired flavor, fragrance, color, and texture, all of which assist to promote patient compliance. Lastly, as designed nutrition items, ONS depend on carbohydrates to supply a required source of energy, which in turn inhibits endogenous sources of energy (LBM and adipose tissue) from being utilized. Healthcare providers need to engage with nutritionally at-risk patients and their families to educate them about the purpose of added sugars in ONS.

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