

Sugar reduction in compound coatings for applications in confectionery, snacks, and sports nutrition

Abstract

Given the high incidence of obesity in many world countries and the recent sugar-reduction intake recommendations by the World Health Organization, reformulation for sugar reduction is a topic of interest to the food industry. Confectionery coatings are not only used in confections but in snacks, nutraceutical, and sports nutrition market segments. Therefore, providing sugar reduction in confectionery coatings, and/or added value in terms of functionality is an attractive offer to many food formulators. In this work, sugar alcohols, soluble fibers, and protein are explored for sugar reduction in confectionery coatings. High-protein coatings are also explored as means to aid formulators trying to deliver high-protein snacks and bars, while achieving sugar reduction.

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The obesity epidemic as a global public health concern

Obesity has long been recognized as a concern of global scale. In the US, which is number one in the world for obesity in adults, the Center for Disease Control describes obesity as a leading cause for preventable deaths associated with cardiovascular disease, stroke and diabetes.¹ Mexico follows the US in adult obesity, and according to UNICEF data, is number one in the world for childhood obesity.² In Argentina and Brazil, 50% of the population are considered to have excessive weight, with both Argentina and Brazil having ~15% of the population being obese in the years 2010 and 2011, respectively.³ With obesity expected to raise if not controlled, many countries are looking for measurements that would prevent its incidence. Some of these measurements are educational, some are legislative, and some impose taxation on high calorie or non-essential food products. For example, Mexico, has implemented an 8% IEPS tax (impuesto especial sobre producción y servicios) that applies to non-basic food products. These food products were defined as those of high caloric value (>275 calories per 100grams), and examples include confectionery products, cocoa-based products, peanut or hazelnut butter, ice-cream, and others.⁴

The World Health Organization (WHO), in an effort to combat the obesity epidemic, provided recommendations for calories control (input versus output), as well as fat and sugar consumption. Regarding sugar, the WHO's guidelines suggest limiting the intake of monosaccharide's and disaccharide sugars (e.g. fructose and sucrose, respectively) to no more than 10% of total daily calories.⁵ Because these sugars can be found in many foods, such as cereals, snacks, sauces, dressings and others, sugar reduction is a current topic of interest in the food industry. The confectionery and snacks market segments, which are traditionally based on the usage of sucrose (table

sugar), are also interested in providing reduced-sugar options and other claims, shown in Table 1. However, sugar-based candy (chews, hard candy, caramels, and others) remain an acceptable product within a healthy diet, as long as consumed in moderation. In this work, sugar reduction in compound coatings (also known as confectionery coatings) is discussed. Compound coatings are used in confectionery applications and snacks, as well as in functional applications and sports nutrition products (e.g. high-protein or high-fiber bars).

Table 1 Possible claims in the US, using sugar alcohols

Reduced calories	Minimum 25% fewer calories per RACC ¹ versus standard product ²
Reduced sugars	Minimum 25% fewer sugars per RACC ¹ versus standard product. May not use this claim in dietary supplements of vitamins and minerals ² .
Sugar-free	Less than 0.5g sugars per RACC ¹ and per labeled serving ² .
No sugar added	"No Added Sugars" and "Without Added Sugars" are allowed if no sugar or sugar containing ingredients are added during processing. The claim does not refer to sugar alcohols, which may be present. For dietary supplements: "Sugar Free" and "No Added Sugar" may be used for vitamins and minerals intended to be used by infants and children less than 2years of age ² .

¹RACC, reference amount customarily consumed

²Information sourced from, guidance for industry, a food labelling guide (9. Appendix A, definitions of nutrient content claims), FDA

<http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm064911.htm>

How is confectionery coating different than chocolate?

Chocolate and compound coating is, generally speaking, different in terms of their legal definition and the ingredients and/or concentration of ingredients that comprise them; however, legislation should be read in each country to understand the definition of chocolate versus that of confectionery coating in specific regions. The Codex Alimentarius established by the WHO and FAO (Food and Agriculture Organization of the United Nations) details specifications for the “standard of identity” of chocolate. According to this standard, chocolate (bittersweet, semi-sweet, or dark) must contain no less than 35% total cocoa solids, containing no less than 18% cocoa butter and no less than 14% fat-free cocoa solids, in a dry basis.⁶ If the chocolate product deviates from this definition, which is usually the case when departing from the use of cocoa butter, the chocolate product is termed compound coating.⁷

Compound coatings usually replace cocoa butter fully or partially with other fats to achieve cost reduction and an increased melting point that facilitates transport and handling. Common fats used in compound coatings are cocoa butter equivalents (CBE), cocoa butter replacers (CBR), and cocoa butter substitutes (CBS). CBE are fully compatible with cocoa butter and therefore work well in partial substitutions; these fats usually have similar triacylglycerols (TAG) and polymorphisms than cocoa butter. CBR are partially compatible with cocoa butter, and are usually obtained from fractionated or fully hydrogenated palm or other vegetable oils.⁷ CBS are cocoa butter incompatible, and are mainly comprised by lauric fats arising from coconut or palm kernel oil. The compatibility or incompatibility of the fats is important, given that mixing cocoa butter with incompatible fats would lead to incorrect crystal structure, challenges during processing, and unfortunate organoleptic parameters.

The manufacturing process for confectionery coatings is somewhat similar to that of chocolate, although it can usually by-pass certain steps or perform these steps for shorter times. For example, chocolate follows the general steps of mixing, refining to a desired particle size (this will influence the non-Newtonian properties of chocolate in terms of viscosity and yield stress), conching to develop flavors, tempering to set the correct crystal structure, molding and demolding after cooling. Coatings also undergo these steps; however the process of conching (which in chocolate may take 24 hours or more depending on the manufacturer) may be considerably shortened or not performed at all. Also, tempering may be avoided depending on the type of fat used. Many CBR are non-polymorphic and crystallize to the correct structure upon cooling.⁸ Compound coatings can be made of milk chocolate, dark chocolate, white chocolate, and flavored chocolate (such as yogurt, lemon, strawberry, and others). The general composition varies among manufacturer, but in general contains sucrose (~50%), cocoa powder, fat, lecithin, and vanillin. Milk chocolate variations may also contain non-fat milk powder. Also, certain additives (depending on the local legislation) may be added to the formulation to improve processing conditions such as crystallization rate, or to modify rheological parameters such as viscosity.

Sugar reduction in confectionery coatings: sugar-alcohols, fibers, and proteins

Sugars belong to the carbohydrate family, and can be of many types and have many different physical properties. Some of

these physical properties include their chemical structure, glass transition temperature, sweetness, solubility, and refractive index. When labelling sugars in foods, sugars refer to the combined monosaccharide's and disaccharide carbohydrates present. Examples of monosaccharide's that may be present in coatings are dextrose and fructose; however, most commonly the sugars present are the disaccharides sucrose (table sugar) and lactose, if milk chocolate. Other types of carbohydrates which are commonly used in sugar-free coatings are sugar alcohols (also known as polyols). These sweeteners can be found in nature, but are most commonly commercially derived from the hydrogenation of monosaccharide or disaccharide sugars, shown in Figure 1. Most polyols have approximately half the calories of sucrose with their sweetness ranging from ~66-90% that of sucrose and offering glycemic impact control, which is crucial when formulating for diabetic individuals. Maltitol, sorbitol, and xylitol are examples of sugar alcohols; however, for confectionery coatings maltitol is the polyol of choice. This is because maltitol has 90% the sweetness of sucrose (therefore it requires no additional high-intensity sweetener), and yields a product with similar rheological properties to that of a sucrose-based control.

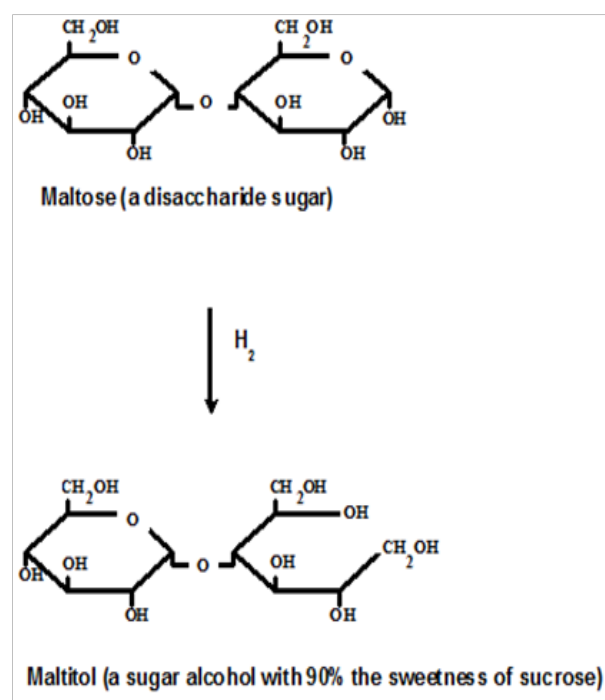


Figure 1 Hydrogenation of the sugar maltose leads to the sugar alcohol maltitol.

Regarding sugar-reduction, in the US this specifically refers to a 25% monosaccharide and/ or disaccharide reduction when compared to a control reference. Strategies to achieve sugar reduction claims in confectionery coatings include the partial substitution of sucrose by other ingredients, such as maltitol, soluble fibers, and proteins. Some examples of soluble fibers are soluble corn fibers (from corn), soluble wheat fiber (from wheat), inulin (from chicory), and others. Since inulin may present some concerns with digestive tolerance, it is important to consider the amount of fiber per serving size of the finished product when using this fiber. In addition, fibers can be processed in different ways leading to various degrees of monosaccharide's and/ or disaccharides in the overall composition. Some soluble corn fiber has low or negligible amounts of monosaccharide's and disaccharides,

and these are ideal for sugar-reduction applications. Both, sugar alcohols and soluble fibers provide excellent tools to the food scientist or product developer that is trying to achieve sugar-reduction in confectionery coatings.

Besides reducing sugars in the overall product, confectionery coatings of reduced sugar can be used to facilitate protein enrichment in snacks, nutraceutical and sports nutrition applications such as chocolate protein bar bites, cereal chocolate clusters, dough, granola, and baked bars. In this case, protein can be used for partial replacement of sucrose and to achieve a protein claim. Soy, whey, and pea proteins can be used for partial sucrose replacement in coatings. Pea protein, which is sourced from yellow peas, is not a major allergen and allows producing confectionery coatings that are also vegan. The resulting reduced-sugar, protein-enriched coatings can then be used for the formulation of reduced-sugars healthful snacks. Also, these type of coatings can aid formulators of high-protein bars so that they can include less protein in the center product (bar) and count with protein in the coating to reach the overall desired protein content in the finished good. For example, to re-formulate a 40grams protein bar that currently delivers 10grams of protein and 6grams of sugar, the bar could be coated with 20% by weight dark chocolate compound coating containing 20% pea protein and 35% sugar reduction. This would lead to 1.6g of pea protein arising from the coating, and the need for 8.4grams of protein in the bar, which aids the mouth feel of the bar center in terms of hydration, and leads to an overall reduced sugar content in the finished product.

Protein in confectionery coating, like any other ingredient, requires refining to bring all components to the desired particle size. Also, when using protein it is advisable to perform some conching (2-4hours) to balance the flavor notes. Pea protein works well with cacao and roasted notes and it has been used in dark chocolate compound coating formulations up to 25% without affecting the crystallization of palm based CBR. Proteins, like any ingredient used for partial replacement of sucrose in reduced sugar coatings should always be tested at the lab bench, since different ingredients and their respective concentrations can affect the rheology of the product. In this sense, plastic viscosity (a function of the shear stress required to maintain constant flow, and an indicator of the ability of the fluid to be pumped and used in molds) and yield value (the minimum shear stress required to initiate chocolate flow and an indicator of “body” and thickness of the coating) do change depending on the ingredients and particle size within the fat dispersion.

Conclusion

Sugar reduction is a topic of current interest to the food industry.

Much of the technology used for sugar-free and reduced-sugars confectionery is also used in snacks and nutraceutical applications to not only reduce sugar but to incorporate functionality and added value. Sugar alcohols, soluble fibers, and protein are bulk ingredients that can be used as partial sucrose substitutes in confectionery coatings. Depending on the ingredient type, concentration, overall particle size when refining, and other processes, the plastic viscosity and yield value of the coating may differ from that of the sucrose control. This inherent differences may be modified to some extent with the use of additives (lecithin, PGPR, others). However, rheological changes are expected and these provide new opportunities in terms of applications for the confectionery, snacks, nutraceutical, and sport nutrition market segments.

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None.

Conflict of interest

Author declares that there is no conflict of interest.

References

1. Center for Disease Control and Prevention. *Adult Obesity Facts*. 2016.
2. <https://www.cdc.gov/obesity/data/adult.html>
3. <http://www.unicef.org/mexico/spanish/17047.htm>
4. ArbexAK, Rocha DRTW, Aizenberg M, et al. Obesity Epidemic in Brazil and Argentina: A Public Health Concern. *J Health Popul Nutr*. 2014;32(2):327–334.
5. USDA Foreign Agricultural Service- 2014 Mexico’s Tax and Social Security Reform
6. World Health Organization. *Guideline: sugars intake for adults and children*. Geneva, Switzerland; 2015. 4p.
7. Joint FAO/WHO Codex Alimentarius Commission. 1992. Codex alimentarius. Rome: Food and Agriculture Organization of the United Nations.
8. Lonchamp P, Hartel RW. Fat bloom in chocolate and compound coatings. *Eur J Lipid Sci Technol*. 2004;106:241–274.
9. Minifie BW. *Chocolate, Cocoa, and Confectionery, Science and Technology*. 3rd ed. MD: Aspen Publication; 1999:165–182.
10. Aidoo RP, Afoakwa EO, Dewettinck K. Rheological properties, melting behaviours and physical quality characteristics of sugar-free chocolates processed using inulin/ polydextrose bulking mixtures sweetened with stevia and thumatin extracts. *LWT-Food Science and Technology*. 2015;62(1):592–597.