

Optimization of ingredients in cereal bar

LATIKA YADAV AND VIBHA BHATNAGAR

The objective of this study was the optimization of ingredient in RTE cereal bar using corn syrup and honey in different ratios. Organoleptic evaluation of RTE cereal bar was done by a panel of ten judges using 9 point hedonic scale. Results showed that 30 per cent incorporation level of corn syrup and honey in cereal bar obtained the highest overall acceptability *i.e.*, CCB (8.39 ± 0.08), HCB (8.18 ± 0.14) and the score was in the range of “like very much” to “like extremely”. Thus it can be concluded that 30 per cent incorporation of corn syrup and honey was highly accepted by panel members.

Key Words : Cereal bar, Corn syrup, CCB (Corn syrup cereal bar), HCB (Honey cereal bar)

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INTRODUCTION

Demand for the processed and convenience foods is increasing rapidly due to the increasing awareness about the health, changing socio-economic needs, and insufficient time to cook food with the correct/ balanced amount of nutrition. One such nutritionally balanced convenience food is the nutritious energy bars, which are gaining popularity in the global market after 1980s. Earlier, these energy bars were used by the sport persons who were involved in strong physical activities and therefore, needed greater source of energy during peak performance. But today, due to the increasing focus on the nutrition and healthy food habits and an increasing number of people involved in greater physical activities, energy bars have become a perfect choice as a quality

source of energy. These energy bars are prepared in the form of tablets either using compression technology or using different binders of choice. The bars contain wide range of nutrients as well as sufficient amount of proteins, fats, and carbohydrates and are available in smaller packets or pouches, light in weight, very convenient to carry and can be eaten at any point of time. There are different types of energy bars referred by different names such as protein bars, meal replacement bars, granola bars, nutraceutical bars, breakfast bars, health bars and so on. Each bar has different characteristic with a different purpose (Sharma, 2011). The new trend for consumption of healthy, innovative and practical food, which has occurred recently, has led the market of cereal-bars to a gradual growth. Cereal bars are considered healthy type of food, because they are rich in fibre, however, poor in fat (Bower and Whitten, 2000 and Palazzolo, 2003). Cereal bars are products obtained from the compression of cereals, containing dried fruits, nuts, flavorings and binder ingredients. Ingredients usually contained in cereal bars are mixtures of cereals, dried fruit, and nuts, corn syrup, honey, sugar, or lecithin and flavorings. Among cereals, pulses is the most widely used

MEMBERS OF RESEARCH FORUM

Author for correspondence :

LATIKA YADAV, Department of Food and Nutrition, College of Home Science, Maharana Pratap University of Agriculture and Technology, UDAIPUR (RAJASTHAN) INDIA
Email : a.lata27@gmail.com

Associate Authors' :

VIBHA BHATNAGAR, Department of Food and Nutrition, College of Home Science, Maharana Pratap University of Agriculture and Technology, UDAIPUR (RAJASTHAN) INDIA
Email : vibhasuresh@gmail.com

to prepare cereal bars due to its high content and quality of protein, predominance of unsaturated fatty acid and composition of dietary fibre (Karam *et al.*, 2001). Sweeteners provide the flavour and texture that consumers enjoy in bars. “some sweeteners, such as corn syrup, provide humectancy to bars keeping the moist over time”. Sweeteners provide the desired texture in bar, such as chewy or crunchy, and also help to keep sugars from crystallizing in bars. Functionally, sweeteners also help ‘bind’ the bar- holding all the little pieces of fruit, nuts, crisps and oat together, helping bars to hold their shape. Sweetness levels and viscosity will be changed without a total reformulation, yet manufacturers need to maintain the original quality and flavour of the product. Honey, brown rice syrup, tapioca syrup, glucose syrup and agave syrup these use as alternatives in bars.

High fructose corn syrup (HFCS) is a sweetener made from corn and can be found in numerous foods and beverages on grocery store shelves in the United States. HFCS is composed of either 42 per cent or 55 per cent fructose, with the remaining sugars being primarily glucose and higher sugars. In terms of composition, HFCS is nearly identical to table sugar (sucrose), which is composed of 50 per cent fructose and 50 per cent glucose. Glucose is one of the simplest forms of sugar that serves as a building block for most carbohydrates. Fructose is a simple sugar commonly found in fruits and honey. HFCS is used in foods and beverages because of the many benefits it offers. In addition to providing sweetness at a level equivalent to sugar (Hanover and White, 1993), HFCS makes foods such as bread and breakfast cereal “brown” better when baked, gives chewy breakfast bars their soft texture and also protects freshness. HFCS keeps products fresh by maintaining consistent moisture. Because it is a highly concentrated “sugar” solution rich in fructose, honey can absorb water readily under certain conditions (White, 1992).

Corn syrup is a common type of glucose syrup, depending on the desired flavour, sweetness, texture and shelf-life desired of the bar. When using honey, most bar manufacturers choose a liquid form. Honey not only provides great sweetness and flavour, but it also helps bind the ingredients together and provides a smooth mouthfeel. Honey also is used in bars to enhance the flavor of other ingredients. Naturally occurring organic acids in honey, such as gluconic acid, enhance the flavours of spices, fruits and nuts. When used with nuts,

cinnamon, herbs, spices or other flavours, honey helps bring out those tastes and aromas. Honey is composed primarily of the sugars glucose and fructose; its third greatest component is water. Honey also contains numerous other types of sugars, as well as acids, proteins and minerals (USDA, 1962; White, 1962). Sugars are also called sweet carbohydrates. Carbohydrates are described by the number of sub-units they contain. Fructose and glucose are monosaccharides, that is, simple sugars. Sucrose, which is composed of fructose and glucose linked together, is a disaccharide; it comprises a little over 1 per cent of the composition of honey. Honey contains other disaccharides which make up over 7 per cent of its composition. Some of the disaccharides in honey are maltose, sucrose, kojibiose, turanose, isomaltose, and maltulose. In addition, honey also contains carbohydrates known as oligosaccharides. These are medium-sized carbohydrates, containing more than three simple sugar sub-units, often made of mono- and disaccharides. Oligosaccharides are sometimes referred to as “higher sugars”(White, 1980). Because it is a highly concentrated “sugar” solution rich in fructose, honey can absorb water readily under certain conditions. Among those components are a variety of other sugars, enzymes, amino acids, antioxidants, vitamins and minerals. It is this unique blend that gives honey its functional advantages (Cindy, 2015).

In some bakery products, honey is added to extend shelf-life and “lock” moisture in the product (NHB and AIB, 1990). Bakers often substitute 10-15 per cent or more of a bakery product’s total sugar with a corresponding amount of honey. Research has also shown that honey can be successfully incorporated at levels as high as 12- 15 per cent in dry products such as breakfast cereals (Neumann and Chambers, 1993), potato chips (Demetriades *et al.*, 1995) and extruded snacks (NHB,1995). It has been suggested that direct incorporation of liquid honey by extrusion processing may impart a protective effect against moisture absorption by the hygroscopic honey components. In 1983, the U.S. Food and Drug Administration listed HFCS as “Generally Recognized as Safe” (known as GRAS status) for use in food, and reaffirmed that ruling in 1996. In its 1996 GRAS ruling, the FDA noted that “the saccharide composition (glucose to fructose ratio) of HFCS is approximately the same as that of honey, invert sugar and the disaccharide sucrose” (or table

sugar). Considering that the consumption of cereal bars has gained importance in recent years, as well as the interest of consumers for functional foods (Bower and Whitten, 2000), this study aimed to optimize and prepare cereal bar containing corn syrup/ honey and to evaluate their organoleptic acceptability.

METHODOLOGY

Cereal bar preparation:

Cereal bars were developed in the laboratory of Food and Nutrition, College of Home Science, Udaipur. Batches of 600g of cereal bars were produced. A baking procedure for bar preparation was adopted by modified method of (Brisske *et al.*, 2004). The process was carried out in three stages: weighing of the dry ingredients (roasted rice flakes, wheat flour, and sesame seeds) on an electronic food balance (F12ATCO) of 1 mg accuracy; Heating of the syrup (corn syrup/Honey, sugar, peanut butter, canola oil, water) to 95°C; mixing of the dry ingredients with the syrup; The prepared mixture was molded then it was cut into rectangular pieces with

approximately 25g each unit and baked at 180°C for 20 minutes in preheated oven; after baking left to rest for cooling and packed into HDPE(High Density Polyethylene) packaging.

Optimization of corn syrup and honey:

The amount of corn syrup and honey which is required for proper setting of cereal bars and to obtain uniform texture was optimized by adding corn syrup and honey at different concentrations ranging from 25 to 40 per cent. The amount of corn syrup and honey was standardized and that amount was kept constant in next trial by using organoleptic evaluation.

Sensory evaluation:

The formulated cereal bars were evaluated for overall acceptability (texture, colour, taste, flavour and appearance) and the sensory evaluation was carried out as per 9 point Hedonic scale; the panel was formed by ten semi trained judges. In Plates A and B, the samples of the cereal bars are presented.

Sr. No.	Ingredients	T ₁	T ₂	T ₃	T ₄	T ₁	T ₂	T ₃	T ₄
1.	Wheat flour	50	50	50	50	50	50	50	50
2.	Rice flakes	50	50	50	50	50	50	50	50
3.	Honey	25	30	35	40	-	-	-	-
4.	Corn syrup	-	-	-	-	25	30	35	40
5.	Sesame seeds	10	10	10	10	10	10	10	10
6.	Peanut butter	10	10	10	10	10	10	10	10
7.	Canola oil	7	7	7	7	7	7	7	7
8.	Sugar	10	10	10	10	10	10	10	10
9.	Salt	1/8tsp	1/8tsp	1/8tsp	1/8tsp	1/8tsp	1/8tsp	1/8tsp	1/8tsp
10.	Vanilla essence	1/2tsp	1/2tsp	1/2tsp	1/2tsp	1/2tsp	1/2tsp	1/2tsp	1/2tsp

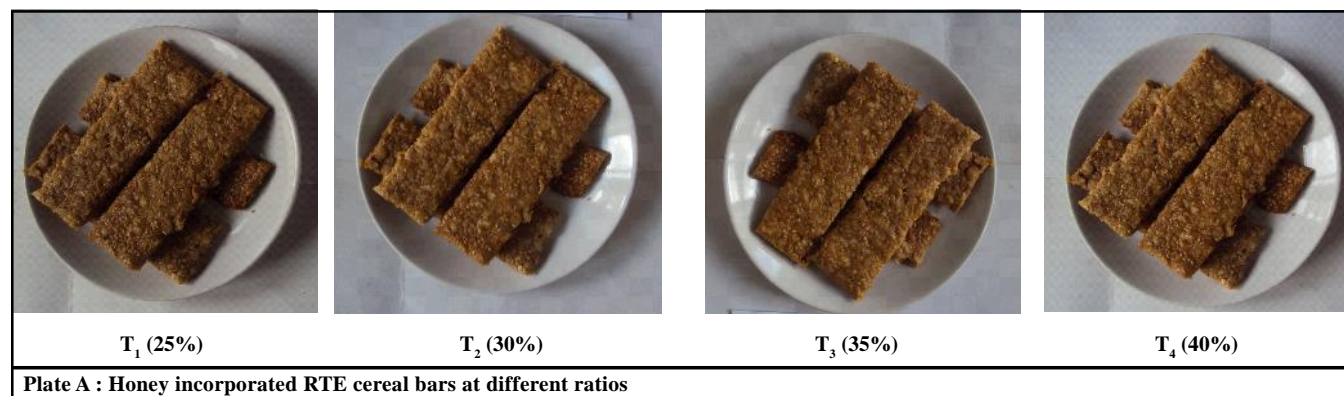
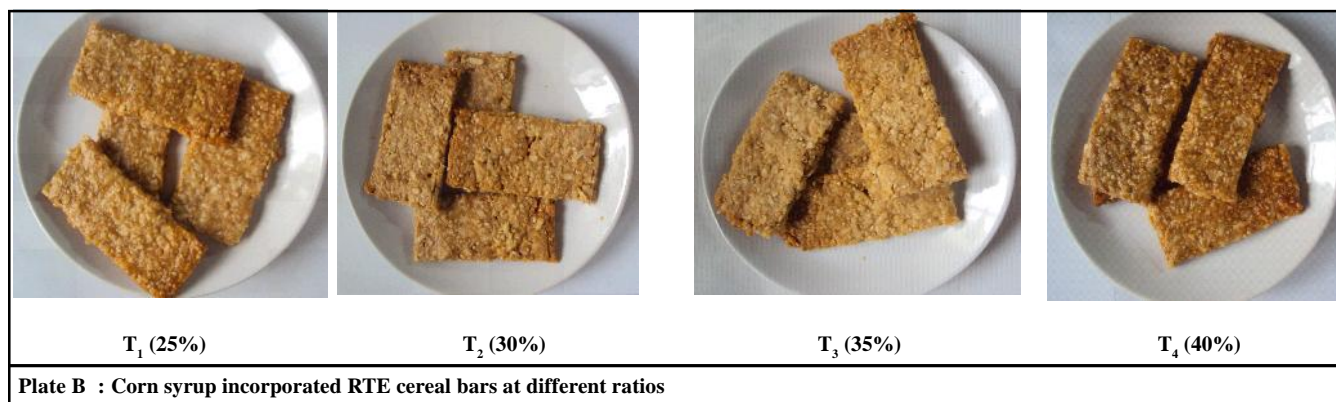


Plate A : Honey incorporated RTE cereal bars at different ratios



Statistical analysis:

The difference in mean acceptability scores of different variation of corn syrup and honey in ready-to-eat cereal bars were analyzed in term of analysis of variance (ANOVA).

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Optimization of honey content of cereal bar by organoleptic evaluation :

Table 1 shows the results of organoleptic evaluation of cereal bars incorporated with honey at different levels. Sensory scores reveal that the cereal bars fell in the category of “liked very much” to “like moderately”. Perusal of the sensory scores as evident from the Table 1 reveals that for T₂ (30% honey) obtained highest scores *i.e.*, 8.36 ± 0.05 for colour, 8.36 ± 0.20 for flavour, 7.26 ± 0.15 for texture, 8.53 ± 0.41 for taste, 8.36 ± 0.05 for appearance and 8.18 ± 0.14 for overall acceptability when compared to others. It is also clear that from overall acceptability point of view T₂ (30% honey) scored the highest of 8.18 ± 0.14 and 7.83 ± 0.18 for T₁ (25% honey),

7.66 ± 0.11 for T₃ (35% honey) and 7.36 ± 0.02 (40% honey), respectively when compared to all treatments.

On an overall acceptability basis it was found that T₂ scored the maximum followed by T₁ and minimum score was obtained by T₄. Among the treatments T₂ was liked the most (Plate A). Therefore, T₂ *i.e.*, 30 per cent incorporation of honey cereal bar were selected for the further study. The results are slightly lower than the findings of Silvino (2011) who, reported that 48.85 per cent honey used in cereal bar preparation. Whereas the percentage of honey used in cereal bar was slightly higher than the findings of Edmilson *et al.* (2011) *i.e.* 26 per cent of honey were used by researcher in cereal bar formulation.

Optimization of corn syrup content of cereal bar by organoleptic evaluation :

The mean sensory scores have been presented in the Table 2. It is clear from the data in the table that all treatments overall acceptability scores ranged from 7.66 ± 0.25 to 8.39 ± 0.08 *i.e.*, “like moderately” to “like very much”. Among all the treatments of cereal bars, sensory scores of T₂ *i.e.*, with 30 per cent level of incorporation was found to be ranked the highest in all sensory attributes *viz.*, 8.36 ± 0.11 for colour, 8.26 ± 0.11 for texture, 8.36

Table 1 : Optimization of honey content of cereal bar by organoleptic evaluation

Parameter	T ₁ (25%)	T ₂ (30%)	T ₃ (35%)	T ₄ (40%)
Colour	8.20 ± 0.10	8.36 ± 0.05	8.00 ± 0.10	7.83 ± 0.05
Texture	6.53 ± 0.15	7.26 ± 0.15	6.70 ± 0.10	6.43 ± 0.15
Flavour	8.03 ± 0.05	8.36 ± 0.20	7.76 ± 0.20	7.43 ± 0.11
Taste	8.06 ± 0.66	8.53 ± 0.41	7.83 ± 0.20	7.66 ± 0.15
Appearance	8.33 ± 0.15	8.36 ± 0.05	8.00 ± 0.10	7.46 ± 0.57
Overall acceptability	7.83 ± 0.18	8.18 ± 0.14	7.66 ± 0.11	7.36 ± 0.02

All the values are mean ± SD

Table 2 : Optimization of corn syrup content of cereal bar by organoleptic evaluation

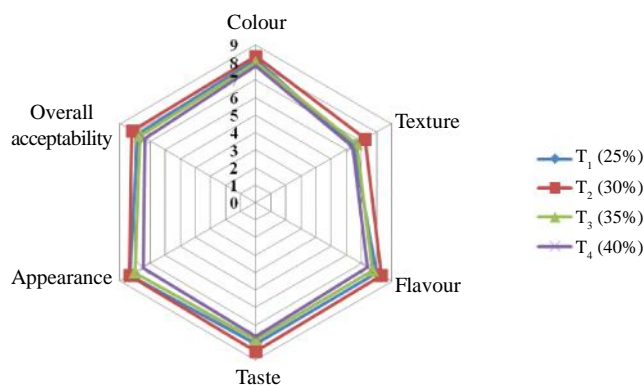
Attributes	T ₁ (25%)	T ₂ (30%)	T ₃ (35%)	T ₄ (40%)
Colour	8.26 ± 0.11	8.36 ± 0.11	8.36 ± 0.05	7.96 ± 0.20
Texture	7.83±0.56	8.26±0.11	7.40±0.40	7.10±0.43
Flavour	8.06 ± 0.11	8.36 ± 0.11	8.06 ± 0.20	7.76 ± 0.23
Taste	8.26 ± 0.15	8.53 ± 0.15	8.00 ± 0.36	7.63 ± 0.20
Appearance	8.26 ± 0.11	8.43 ± 0.11	8.03 ± 0.15	7.86 ± 0.23
Overall acceptability	8.14± 0.20	8.39 ± 0.08	7.94 ± 0.26	7.66 ± 0.25

All the values are in mean“±”SD

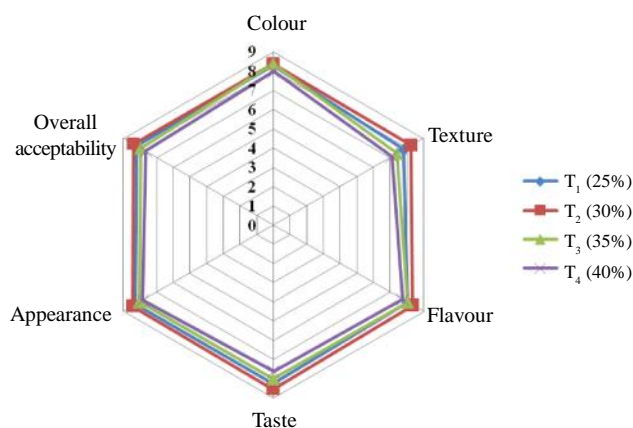
Table 3 : The highest optimized recipe of cereal bars

Ingredients (g)	HCB	CCB
Wheat flour	50	50
Rice flakes	50	50
Honey	30	-
Corn syrup	-	30
Sesame seeds	10	10
Peanut butter	10	10
Canola oil	7	7
Sugar	10	10
Salt	1/8tsp	1/8tsp
Vanilla Essence	1/2tsp	1/2tsp

HCB: Honey cereal bar; CCB: Corn syrup cereal bar

**Fig. 1 : Optimization of honey content of cereal bar by organoleptic evaluation**

± 0.11 for flavour, 8.43 ± 0.11 for appearance, 8.53 ± 0.15 for taste and 8.34 ± 0.08 for overall acceptability than the other cereal bars prepared with 25, 35 and 40 per cent level of corn syrup (Plate B). The acceptability scores ranged between 8.26 ± 0.11 to 8.53 ± 0.15 indicating that the cereal bars fell under the category of “liked very much”. The results are in agreement with findings of Nathalia *et al.* (2013), who used 31 per cent of glucose syrup in formulation of cereal bars. But Flavia

**Fig. 2 : Optimization of corn syrup content of cereal bar by organoleptic evaluation**

et al. (2012) have reported a slightly lower percentage of (26%) glucose syrup used in cereal bar formulation. Whereas the percentage of corn syrup used by Adriana *et al.* (2011) was quite higher *i.e.* 35 per cent for formulation of cereal bar.

Further it can be discerned that there was an increase in the scores of the sensory attributes with the increase in the incorporation level of corn syrup up to 30 per cent, the sensory scores decreased with a further increase of incorporation level of corn syrup to 40 per cent. It is clear from the data that the panelist liked the cereal bar with 30 per cent incorporation of corn syrup very much on an overall basis. Hence, T₃ of cereal bar were selected for the further study.

It is evident from the result in Table 1 and 2 that accepted CCB was the most appreciated when compared to the accepted HCB. On an overall acceptability basis it was found that CCB (8.39 ± 0.08) scored the maximum scores as compared to HCB (8.18 ± 0.14) which was the highest score obtained by the product and was “liked very much” by the panel members. With regards to all the sensory attributes CCB obtained highest score ranged from 8.26 ± 0.11 to 8.53 ± 0.15 “liked very much” where

as HCB ranged from 7.26 ± 0.15 “liked moderately” to 8.53 ± 0.41 “liked very much”. From organoleptic evaluation of cereal bar the optimized recipe was obtained and from which the highest is given in the Table 3.

Conclusion :

Conclusively, it emerges that cereal bars were successfully prepared by using corn syrup and honey in a specific percentage and the bar was baked at 180°C for 20 minutes and thus the recipe was optimized. According to the organoleptic qualities, corn syrup incorporated cereal bar was excellent attributed as compared to honey incorporated cereal bar. Corn syrup work as good binding agent compared to honey in cereal bar optimization.

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