



## THE EVALUATION OF SOME DIETARY FIBER RICH BY-PRODUCTS IN ICE CREAMS MADE FROM THE TRADITIONAL PUDDING – KESME MUHALLEBI

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### ABSTRACT

*The objective of this study was to investigate the effects of dietary fiber (DF)-rich by-products in Turkish traditional pudding kesme muhallebi and ice cream made from it. For this purpose, corn pulp, black carrot and apricot pomace were added in dessert samples. Dessert and ice cream samples were analyzed for their sensory attributes and textural properties. Black carrot pomace added samples had the lowest sensory attributes, while corn pulp added samples had comparable results with control samples. The obtained results in this study showed that the sensory properties of the desserts weren't affected adversely with the addition of DF materials except for black carrot. Some of the food industry wastes can be available processing aids in functional food production. In addition, kesme muhallebi dessert was successfully introduced into ice cream, with higher sensorial attributes.*

**Keywords:** Kesme muhallebi, Pudding, Ice cream, By-products, Dietary fiber.

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### Contribution/ Originality

This study contributes in the existing literature of dietary fiber rich by-products from food processing as a source of functional materials that can be evaluated in dairy products.

## 1. INTRODUCTION

Fruits and vegetables can be divided into two categories for waste management; avoidable parts are edible and unavoidable parts are inedible food materials like peels, bones, pomaces, etc. The pomace, which consists of peel, seed, pulp, etc., represents the 25-35% of raw material. According to the data obtained from the Food and Agriculture Organization of the United Nations (FAO), fruits and vegetables have the highest wastage rates in all food products; 45% of the fruits and vegetables are wasted. Also, as FAO highlighted in the report of Global food losses and food waste: extent, causes and prevention (Gustavsson *et al.*, 2011) most of waste occurs during processing. Some of these wastes are valuable by-products and they are used in animal feed or in land fertilizing. However, there are only a limited number of studies to evaluate them in human nutrition.

Most of the fruit and vegetable wastes are rich in dietary fiber, however cannot be utilized as a source of fiber. Black carrot pomace is rich in both anthocyanins and DF (Nawirska and Uklańska, 2008). Apricot pomace is a good source of  $\beta$ -carotene and DF (Sanal *et al.*, 2005; Seker *et al.*, 2009). Corn pulp also is a good source of DF (Awolu and Ibileke, 2011). DF is a component of some plants that is not digested in the gastrointestinal tract. However, part of it may be metabolized by bacteria in the lower gut. These anaerobic bacteria in the colon ferment fiber, into short-chain fatty acids. The fatty acids bind receptors known as “immune system cells” (Tan *et al.*, 2016). In addition to the benefits to immune system, DF helps to maintain cardiovascular health, normalizes blood lipids, promotes bowel regularity and regulates blood sugar levels as demonstrated in numerous studies (Willis *et al.*, 2009; Othman

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*et al.*, 2011; Huang *et al.*, 2015). The Nutrition Facts label is based on 25 g of fiber recommended daily for a 2000 calorie diet. However, most people consume only 10-15 g/day (Institute of Medicine (IOM) Food and Nutrition Board, 2002).

Turkish cuisine has many traditional fresh dairy desserts. Rice pudding-sütlaç, pudding with a caramel base-kazandibi, chicken breast pudding-tavuk göğsü, a type of milk pudding-muhallebi and sliced type of pudding (kesme muhallebi) are just a few of them. These desserts are preferred for their high nutritional values in comparison to syrupy desserts. For the last decades, improvements on healthy diet increased considerably. Functional and natural products are preferred, and regulations also limit high levels of sugar as well.

In this study, the evaluation of DF rich by-products in dairy industry was aimed. Also, the traditional Turkish dessert-kesme muhallebi was further processed into ice cream to investigate for a universally accepted taste.

## 2. MATERIALS & METHODS

### 2.1. Materials

DF rich by-products were obtained from different food plants in Turkey. Black carrot and apricot pomaces from fruit juice plant (Bursa) and corn pulp from oil plant (Kırklareli) were used in this study. Milk from UHT process (with 11.5% total solids, 3% fat, 3.4% protein), and butter (with 82% fat) were obtained from AK Gıda (Sakarya). Other ingredients (salep, starch, sugar, vanilla and flour) were supplied from the local markets in Sakarya, Turkey. The content of salep was 34% glucomannan, 15% starch, 2.4% sucrose, 1.0% protein, 4.5% ash.

The total DF contents of the pomaces and pulp were analyzed in dry matter according to AACC (2000) method as; 68.0 % in black carrot pomace, 72.3 % in apricot pomace, and 67.2 % in corn pulp.

### 2.2. Methods

#### 2.2.1. The Production of Kesme Muhallebi

The production steps of kesme muhallebi are given in Figure 1 and the formulations of DF rich- kesme muhallebi are given in Table 1.

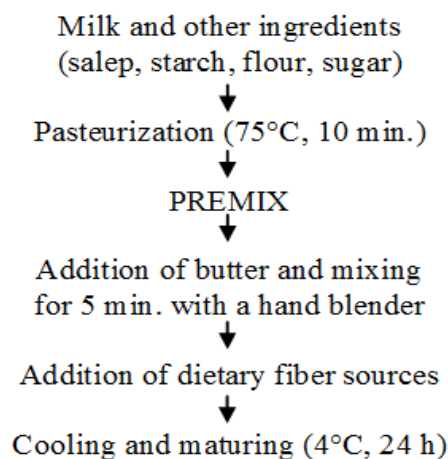


Figure-1. The production steps of kesme muhallebi

Table-1. The formulations of kesme muhallebi (%)

Ingredients	Milk	Sugar	Flour	Starch	Butter	Vanilla	Salep	DF source
KM0	74.6	11.6	3.8	3.8	3.0	$8.7 \times 10^{-4}$	0.2	0.0
KM1	74.6	11.6	3.8	3.8	3.0	$8.7 \times 10^{-4}$	0.2	3.0 black carrot pomace
KM2	74.6	11.6	3.8	3.8	3.0	$8.7 \times 10^{-4}$	0.2	3.0 apricot pomace
KM3	74.6	11.6	3.8	3.8	3.0	$8.7 \times 10^{-4}$	0.2	3.0 corn pulp

KM0: Control sample, KM1: Black carrot pomace, KM2: Apricot pomace, KM3: Corn pulp added kesme muhallebi

### 2.2.2. The Kesme Muhallebi Ice Cream Production

After maturing the kesme muhallebi at 4°C for 24 h, the muhallebi were processed into a household ice cream machine (Gelataio SIMAC, GC 6000 brand) and treated for 30 minutes at -18°C. Then, the ice creams were allowed to harden at the same temperature. Sensorial analyses were done in both kesme muhallebi and the ice cream samples. Textural analyses of the ice creams were done at the 1st day of storage.

### 2.2.3. Sensorial and Textural Analyses

The sensory evaluation of dessert and ice cream samples were carried out with 10 semi-trained panel members. Flavor, texture, and overall acceptability were evaluated using 9 point Hedonic rating scale, where 9 = like extremely and 1 = dislike extremely (Stone and Sidel, 2004).

Overrun measurements were taken for each ice cream, by comparing the weights of ice cream and mix, in a fixed volume container (Ferraz *et al.*, 2012). Overrun was calculated according to the equation;

$$\text{Overrun \%} = 100 \times (\text{mix weight} - \text{ice cream weight}) / \text{ice cream weight}$$

Viscosity of the ice cream mixes was determined by a rotational viscometer (Fungilab, ALPHA H, Spain) with spindle R4, at 50 rpm, at 15°C. Each result in triplicate was recorded in terms of Poise (P) after 30 s rotation.

Texture analyses of ice cream samples were performed by using TA4/1000 probe of Brookfield Model CT3 Texture Analyzer (Brookfield Engineering Laboratories, USA). The compression test parameters were; 4.5g trigger force, 30mm distance, 1 mm/s test speed. Viscosity and textural profile of ice cream samples were measured after holding the ice creams at 4°C for 5 h.

## 3. RESULTS AND DISCUSSION

Sensorial results of DF material added kesme muhallebi and ice creams made from these kesme muhallebi are given in Table 2.

**Table-2.** The sensorial scores of kesme muhallebi and ice cream samples

Sample name	Flavor	Texture	Overall acceptability
KM0	7.7	7.5	8.5
KM1	4.9	5.6	6.2
KM2	7.5	7.1	7.2
KM3	7.2	7.1	7.5
IC0	7.2	7.7	7.8
IC1	7.1	6.8	7.6
IC2	7.2	7.1	7.8
IC3	7.7	7.9	8.3

**KM0:** Control sample of kesme muhallebi, **KM1:** Black carrot pomace, **KM2:** Apricot pomace, **KM3:** Corn pulp added kesme muhallebi; **IC0:** Control sample of ice cream, **IC1:** Black carrot pomace, **IC2:** Apricot pomace, **IC3:** Corn pulp added ice cream

According to the results given in Table 2, black carrot pomace added dessert samples had the lowest sensorial scores in terms of flavor, texture and overall acceptability. However, processing of the kesme muhallebi into ice cream had importantly increased the attributes. The overall acceptability of black carrot pomace added kesme muhallebi was increased from 6.2 to 7.6, when processed into ice cream. In the study of Turksoy *et al.* (2011) black carrot pomace had increased the water absorption of cookie dough; however, the overall acceptance scores had decreased with the increasing amount of black carrot concentration.

In kesme muhallebi group, the control sample had the highest flavor, texture and overall acceptability scores. However, when they were processed into ice cream, corn pulp added sample had the highest scores in all categories, while the other DF added samples were pointed closer to the control sample.

While the sensorial attributes had differed, the analytical texture measurements of apricot pomace and corn pulp added ice creams were closer to each other in our study. In a study on DF fortified plain yogurts, corn and oat fiber added yogurts had comparable results, however they had significantly lower attributes when compared to control sample, in terms of flavor and other sensorial categories (Fernández-García and McGregor, 1997).

The textural properties of ice cream samples are given in Table 3. Black carrot pomace added ice cream sample had the lowest overrun value, while its viscosity was measured as the highest. Adhesiveness forces and springiness distances of the black carrot pomace added sample was also the lowest in all, with the values of 22.4 mJ and 4.7 mm, respectively. Singh *et al.* (2016) were measured the springiness of black carrot pomace added rice muffins and found that, springiness had increased with 3% addition of pomace, while it decreased in 6% and 9% addition of the pomace. The highest adhesiveness force and springiness distance was measured in the control sample with the values of 61.9 mJ, and 40.7 mm, respectively. The textural profile of apricot pomace and corn pulp added samples were closer to each other.

**Table-3.** The textural properties of ice cream samples made from DF source added kesme muhallebi

Sample name	Overrun (%)	Viscosity (P)	Adhesiveness (mJ)	Springiness (mm)
IC0	10.6	3.3	61.9	40.7
IC1	3.8	20.3	22.4	4.7
IC2	18.7	6.9	47.4	22.5
IC3	16.8	7.8	48.3	25.6

IC0: Control sample, IC1: Black carrot pomace, IC2: Apricot pomace, IC3: Corn pulp added ice cream

#### 4. CONCLUSION

The information obtained from the analytical texture evaluation revealed that, apricot pomace and corn pulp DF materials can be suitable for the manufacture of kesme muhallebi-ice cream, while the black carrot pomace affected the textural properties significantly, when compared with the control sample. The source of fiber also affected the sensorial results of both kesme muhallebi and ice creams made from it. Corn pulp had the highest sensorial attributes in all of the ice creams and was found available to be used in both kesme muhallebi and ice cream, when compared to the control samples. Apricot pomace added ice cream had the same overall acceptability score with the control sample. It's suggested to be studied further, with different concentrations of these DF materials.

This study revealed that, DF rich by-products can be used in innovative food production. The evaluation of DF rich by-products can be a good solution to food wastage and environmental pollution, as well. The purpose of new trend "healthy food consuming" can be met by supporting the diet with these DF rich by-products.

The study also showed that, introduction of some traditional dairy desserts into ice cream will be a good solution for carrying them into universal scale.

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