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Effects of carrageenam and guar gum on the cooking and textual properties of low fat meatballs

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Abstract

Low fat meatballs (10% fat, formulated with 10% water, 3.2% spice mixture and 0.5–1% carrageenan or guar gum) were evaluated for cooking characteristics and compared with controls of higher fat content. A reduction in the fat level from 25% to 10% improved all cooking parameters with respect to better cooking yield ($p < 0.05$) and fat retention ($p < 0.05$). Addition of increasing levels of carrageenan to low fat meatballs was more effective than guar gum for the textural properties after cooking.

Keywords: Low fat meatball; Carrageenan; Guar gum; Texture

1. Introduction

Today's consumers are health- and nutrition-conscious and tend to avoid food products with high fat content. Comminuted meat products contain approximately 20–30% fat; therefore it is essential for the meat industry to reduce the fat contents of their products (Candoğan & Kolsarıcı, 2003; Trius & Sebranek, 1996). In meat products, fat contributes to flavour, texture and mouth feel; therefore fat reduction by itself can significantly affect the acceptability of the product. One of the major problems in reducing fat level in a meat product is increase in the toughness and therefore decrease in its acceptability (Lyons, Kerry, Morrissey, & Buckley, 1999; Mittal & Barbut, 1993; Pietrasik & Duda, 2000; Xiong, Noel, & Moody, 1999).

Many food ingredients and additives are used as supplements in food formulations to replace the textural, functional and flavour characteristics of fat (Mittal & Barbut, 1993). Some studies have reported applications of various hydrocolloids in meat products as meat binders, texture stabilizers and/or fat substitutes (Berry, Joseph, & Stanfield, 1996; Hsu & Chung, 1999, 2000; Lyons et al., 1999). When hydrocolloids are used in low fat meat formulation, a certain amount of water (around 10–20%, depending on product type) needs to be added. Water addition provides an environment for a desirable texture by interacting with hydrocolloids (Candoğan & Kolsarıcı, 2003).

Meat and meat products are usually marketed in small butcher shops as steaks and or in the ground form in Turkey, and most people prefer to consume meat and meat products in the ground form. Therefore, many meat products, such as patties, meatballs, and kebabs, prepared from ground meat, are consumed in Turkey (Ulu, 2004; Yılmaz & Dağlıoğlu, 2003). Hence, manufacturing of foods, such as low-fat meat products, is of both economical and health value (Yılmaz & Dağlıoğlu, 2003).

The objective of this study was to evaluate the effects of hot processing and use of carrageenan or guar gum on textural and cooking properties of low fat meatballs.

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2. Materials and methods

2.1. Preparation of meatballs

The meat, fat, spices, additives and ingredients used in the experiments are those typically used for meatball manufacture and supplied by Pinar Food Group (Pinar Integrated Meat and Feed Industries Inc., Izmir, Turkey). Meatballs were produced according to the following traditional recipe: in three sets of separate experiments, samples were prepared using ground beef (max. 10% fat). Controls were formulated to have 10%, 15% and 25% fat using a minced ground beef, beef tallow and spices mixture. The meatball formulations for the experiments are presented in Table 1. The spice mixture is given in Table 2.

Each portion was kneaded for 30 min, by hand, to obtain a homogeneous dough. The dough was stored in a cold room (+4 °C) for 1 day and then shaped into 6 cm diameter and 1.5 cm height meatballs with a weight of 50–60 g. Meatballs were placed between inter-leafing discs and sealed in plastic bags.

Meatballs were cooked according to a standard protocol of 3, 2 min and then 15 s. on each side to achieve an internal end-point temperature of 71 °C (measured with a thermocouple), using an electric household grill heated to 170–190 °C.

2.2. Chemical analysis

Moisture and fat contents were determined according to the methods described by the AOAC (1990).

Table 2
Spices mixture

Spice	%
Red pepper	0.5
Black pepper	0.4
Cumin	0.4
Allspice	0.3
Garlic powder	0.1
Salt	1.5

Cooking yield and fat retention were calculated according to the following equations;

$$\%\ \text{cooking yield} = \frac{\text{cooked weight}}{\text{raw weight}} \times 100,$$

$$\%\ \text{fat retention} = \frac{\text{cooked weight} \times \%\ \text{fat of cooking meatball}}{\text{raw weight} \times \%\ \text{fat of raw meatball}} \times 100,$$

$$\%\ \text{moisture retention} = \frac{\%\ \text{cook yield} \times \%\ \text{moisture of cooked meatball}}{100}.$$

This moisture retention value represents the amount of moisture retained in the cooked product per 100 g of raw samples. Adjusted yields were calculated as the yield per 100 g of meat constituents (Berry, Bigner-George, & Eastridge, 1999; El-Magoli, Laroia, & Hansen, 1996).

Shrinkage was determined according to an equation by El-Magoli et al. (1996)

$$\%\ \text{shrinkage} = \frac{(\text{raw thickness} - \text{cooked thickness}) + (\text{raw diameter} - \text{cooked diameter})}{\text{raw thickness} + \text{raw diameter}} \times 100.$$

Table 1
Product formulations (g/1000 g) and sample codes

Sample codes	Meat	Tallow	Water	CA[a]	GG[a]	SM[a]
High fat (control)	778	190	0	0	0	32
High fat + %0.5 CA	673	190	100	5	0	32
High fat + %1 CA	668	190	100	10	0	32
High fat + %0.5 GG	673	190	100	0	5	32
High fat + %1 GG	668	190	100	0	10	32
Medium fat (control)	868	100	0	0	0	32
Medium fat + %0.5 CA	763	100	100	5	0	32
Medium fat + %1 CA	758	100	100	10	0	32
Medium fat + %0.5 GG	763	100	100	0	5	32
Medium fat + %1 GG	758	100	100	0	10	32
Low fat (control)	968	0	0	0	0	32
Low fat + %0.5 CA	863	0	100	5	0	32
Low fat + %1 CA	858	0	100	10	0	32
Low fat + %0.5 GG	863	0	100	0	5	32
Low fat + %1 GG	858	0	100	0	10	32

[a] CA = carrageenan; GG = guar gum; SM = spices mixture.

2.3. Texture profile analysis

After cooking and cooling to room temperature, three whole meatballs were subjected to texture profile analysis using the Texture Analyzer (TA plus, LLOYD Instruments, A trademark of Ametek Inc.) as described by Bourne (1978). The meatball was placed on the platform of the Texture Analyzer. A cylinder plunger of 6 mm diameter was attached to a 50 kg load cell and the sample was compressed (at three different locations) to 80% of its original height at a cross head speed of 100 mm/min, twice in two cycles. The following parameters were obtained:

Hard hardness (N); breaking force of the product at the first loading cycle in texture profile analysis,

Cohe cohesiveness; the ratio of storage work to total work in the second loading cycle in texture profile analysis,

Sprin springiness (mm); the ratio of storage deformation to total deformation in the second loading cycle in texture profile analysis,

Chew chewiness (N mm); hardness × cohesiveness × springiness,

Gumm gumminess (N); hardness × cohesiveness,

Adhe adhesiveness (N mm); the work needed to pull out the plunger from the sample in the first unloading cycle in texture profile analysis.

2.4. Statistical analysis

All data analysis was performed using SPSS for Windows, release 7.5.2.S (1995). The statistical significances of the differences between means were determined by using Fisher's least significance difference (LSD) test.

3. Results and discussion

The chemical compositions for raw and cooked meatballs (Table 3) varied as expected. The moisture content was inversely proportional to the fat content (i.e., higher moisture in lower fat products). This was the result of fat substituted by moisture in the low fat products (Pietrasik & Duda, 2000). Significant differences were detected between the moisture contents of the raw and cooked formulations. In addition, meatballs with added guar gum have higher moisture during cooking than meatballs with carrageenan.

Table 4 shows the cooking characteristics for the meatballs. Cooking yield results are the most important test for the meat industry to predict the behaviour of the products during cooking due to non-meat ingredients or other factors (Pietrasik & Li-Chan, 2002). Comparison, among the controls, shows that a reduction in the fat level, from 25% to 10%, improved all of the cooking parameters with respect to higher yield, better fat retention and reduced shrinkage. In the series of high fat products, adding carrageenan or guar gum resulted in lower fat retention and shrinkage then with the control. Recipes that contained 1% guar gum had higher yields, better fat retention and moisture retention and lower shrinkage than the other high fat samples.

Adding 10% water to the low fat meat caused an increase of moisture content in the cooked samples. Thus, water added to lean beef appears to be satisfactorily retained within the meat matrix, so that the product does not become dehydrated again during cooking (El-Magoli et al., 1996). In the low fat meatballs that were cooked, moisture content was significantly ($p < 0.05$) higher for the guar gum series than for the others. This was apparently a result of the added water per se, rather than

Table 3
Chemical composition (%) of formulated meatballs*

Sample codes	Raw		Cooked	
	Fat	Moisture	Fat	Moisture
High fat (control)	25.94 ± 1.42^{a}	48.32 ± 1.42^{a}	17.42 ± 1.51^{a}	54.84 ± 0.22^{abd}
High fat + %0.5 CA[A]	22.14 ± 0.80^{a}	47.83 ± 3.00^{a}	9.67 ± 0.45^{bc}	55.39 ± 2.68^{ad}
High fat + %1 CA	21.29 ± 0.05^{a}	52.32 ± 5.30^{a}	8.26 ± 0.20^{b}	47.69 ± 0.06^{bd}
High fat + %0.5 GG[A]	24.53 ± 4.62^{a}	51.21 ± 2.54^{a}	11.60 ± 3.02^{cd}	56.05 ± 6.50^{ad}
High fat + %1 GG	25.81 ± 4.18^{a}	40.69 ± 2.61^{b}	12.79 ± 0.97^{d}	54.85 ± 5.30^{ad}
Medium fat (control)	13.64 ± 1.50^{bc}	60.93 ± 2.01^{c}	10.51 ± 1.47^{b}	57.56 ± 1.04^{acd}
Medium fat + %0.5 CA	12.97 ± 1.22^{bc}	63.89 ± 0.31^{cef}	9.92 ± 0.11^{c}	50.41 ± 1.64^{d}
Medium fat + %1 CA	11.19 ± 1.18^{b}	65.95 ± 1.11^{de}	9.86 ± 0.08^{c}	58.59 ± 0.85^{ac}
Medium fat + %0.5 GG	13.39 ± 0.79^{bc}	63.29 ± 0.67^{cef}	8.93 ± 0.10^{d}	59.76 ± 0.99^{ac}
Medium fat + %1 GG	16.70 ± 3.12^{c}	59.80 ± 1.61^{c}	8.89 ± 1.21^{d}	62.99 ± 0.83^{c}
Low fat (control)	7.65 ± 1.38^{de}	66.37 ± 0.32^{df}	8.21 ± 0.58^{d}	52.67 ± 0.15^{abd}
Low fat + %0.5 CA	7.40 ± 1.01^{de}	67.09 ± 0.14^{df}	8.36 ± 0.52^{d}	54.23 ± 0.56^{abd}
Low fat + %1 CA	9.51 ± 1.10^{d}	66.57 ± 1.54^{df}	9.16 ± 0.26^{cd}	53.51 ± 3.21^{abd}
Low fat + %0.5 GG	8.01 ± 0.01^{de}	68.86 ± 0.43^{d}	7.73 ± 0.27^{d}	59.53 ± 0.71^{ac}
Low fat + %1 GG	6.58 ± 0.37^{e}	69.24 ± 0.60^{d}	8.10 ± 0.34^{d}	59.44 ± 1.46^{ac}

[A] CA = carrageenan; GG = guar gum.

* Means with the same superscript are not different ($p > 0.05$).

Table 4
Cooking characteristics of formulated meatballs*

Sample codes	% Cooking yield	Adj. yield[B]	Fat retention	Moisture retention	Shrinkage
High fat (control)	63.93^{ac}	66.04^{a}	42.95^{ab}	35.06^{bcd}	27.71^{a}
High fat + %0.5 CA[A]	60.81^{a}	70.46^{ab}	26.57^{c}	33.68^{ab}	25.85^{abd}
High fat + %1 CA	63.80^{ac}	74.36^{b}	24.77^{c}	30.43^{a}	25.44^{abde}
High fat + %0.5 GG[A]	56.25^{b}	65.18^{a}	28.66^{c}	31.53^{ab}	25.93^{ab}
High fat + %1 GG	65.02^{c}	75.78^{b}	32.82^{ac}	35.66^{bd}	21.09^{df}
Medium fat (control)	67.68^{ce}	69.92^{ab}	52.06^{be}	38.96^{df}	20.42^{bcd}
Medium fat + %0.5 CA	62.47^{ac}	72.39^{b}	48.00^{b}	31.49^{ac}	21.67^{bdf}
Medium fat + %1 CA	74.05^{fg}	86.31^{c}	65.56^{ef}	43.38^{ef}	19.58^{cd}
Medium fat + %0.5 GG	64.16^{ac}	74.35^{b}	42.83^{ab}	38.34^{df}	19.58^{cd}
Medium fat + %1 GG	70.39^{eg}	82.04^{c}	37.71^{bc}	44.33^{ef}	19.17^{cef}
Low fat (control)	87.34^{d}	90.23^{d}	94.70^{g}	46.00^{e}	14.17^{c}
Low fat + %0.5 CA	75.44^{f}	87.42^{cd}	86.44^{dg}	40.91^{f}	17.08^{cfg}
Low fat + %1 CA	74.83^{fg}	87.21^{cd}	72.80^{df}	40.05^{f}	17.50^{cfg}
Low fat + %0.5 GG	71.11^{efg}	82.40^{c}	68.63^{f}	42.33^{ef}	22.08^{abdg}
Low fat + %1 GG	69.42^{e}	80.91^{c}	85.76^{dg}	41.26^{f}	17.50^{cfg}

[A] CA = carrageenan; GG = guar gum.
[B] Adj. yield = adjust yield per 100 g of meat.
* Means with the same superscript are not different ($p > 0.05$).

caused by the guar gum, because no significance could be attributed to levels of guar gum addition ($p > 0.05$). The moisture content and moisture retention were higher for meatballs which had added guar gum in contrast to those made from carrageenan. However, yield was significantly higher for the carrageenan series. Particularly in the low fat meatballs with added carrageenan, yield and fat retention were higher ($p < 0.05$). It is

Table 5
Texture profile analysis of raw meatballs**

Sample codes	Hard	Cohe	Sprin	Gumm	Chew	Adhe
High fat (control)	2.38^{a}	0.217^{ac}	4.76^{ac}	0.508^{a}	2.47^{a}	0.213^{ad}
	(0.35)*	(0.05)	(0.39)	(0.09)	(0.56)	(0.05)
High fat + %0.5 CA[A]	1.37^{cdf}	0.239^{ab}	5.77^{b}	0.326^{bdg}	1.90^{bd}	0.591^{bce}
	(0.11)	(0.05)	(0.63)	(0.06)	(0.49)	(0.30)
High fat + %1 CA	1.63^{ce}	0.172^{a}	4.78^{ac}	0.282^{def}	1.38^{cd}	0.393^{ade}
	(0.12)	(0.05)	(0.67)	(0.08)	(0.51)	(0.28)
High fat + %0.5 GG[A]	1.09^{bd}	0.269^{bd}	4.73^{ad}	0.266^{efg}	1.25^{ce}	0.263^{ad}
	(0.55)	(0.07)	(0.83)	(0.05)	(0.20)	(0.20)
High fat + %1 GG	1.11^{bd}	0.301^{be}	5.23^{bc}	0.302^{de}	1.60^{df}	0.358^{dfg}
	(0.42)	(0.10)	(0.73)	(0.06)	(0.44)	(0.18)
Medium fat (control)	1.32^{cdf}	0.236^{ab}	4.78^{ac}	0.310^{de}	1.48^{cd}	0.143^{a}
	(0.15)	(0.03)	(0.32)	(0.04)	(0.18)	(0.07)
Medium fat + %0.5 CA	1.39^{cd}	0.161^{a}	4.49^{a}	0.213^{cf}	0.96^{c}	0.170^{ag}
	(0.34)	(0.04)	(0.32)	(0.01)	(0.01)	(0.07)
Medium fat + %1 CA	1.47^{cd}	0.223^{ad}	4.83^{ac}	0.322^{dg}	1.56^{def}	0.411^{bdfg}
	(0.33)	(0.04)	(0.12)	(0.04)	(0.21)	(0.09)
Medium fat + %0.5 GG	0.89^{bf}	0.219^{ad}	4.81^{ac}	0.191^{c}	0.94^{c}	0.264^{af}
	(0.11)	(0.06)	(0.29)	(0.04)	(0.35)	(0.13)
Medium fat + %1 GG	0.78^{b}	0.304^{bd}	5.41^{bc}	0.231^{ce}	1.26^{cf}	0.538^{bcef}
	(0.12)	(0.09)	(0.46)	(0.46)	(0.35)	(0.25)
Low fat (control)	1.18^{bde}	0.292^{bcd}	5.60^{b}	0.346^{bd}	1.94^{bd}	0.655^{bc}
	(0.22)	(0.03)	(0.41)	(0.08)	(0.49)	(0.23)
Low fat + %0.5 CA	1.78^{c}	0.230^{ade}	5.27^{bd}	0.410^{b}	2.19^{ab}	0.373^{adef}
	(0.45)	(0.02)	(0.49)	(0.10)	(0.74)	(0.22)
Low fat + %1 CA	1.71^{c}	0.296^{bd}	5.39^{bc}	0.502^{a}	2.70^{a}	0.521^{be}
	(0.23)	(0.03)	(0.28)	(0.05)	(0.26)	(0.21)
Low fat + %0.5 GG	0.73^{b}	0.323^{b}	5.40^{bc}	0.235^{ce}	1.27^{cf}	0.650^{bc}
	(0.14)	(0.03)	(0.34)	(0.04)	(0.21)	(0.13)
Low fat + %1 GG	1.09^{bd}	0.278^{bcd}	5.52^{bc}	0.287^{de}	1.58^{def}	0.790^{c}
	(0.28)	(0.06)	(0.34)	(0.01)	(0.23)	(0.09)

[A] CA = carrageenan; GG = guar gum.
* Standard deviation.
** Means with the same superscript are not different ($p > 0.05$).

Table 6
Texture profile analysis of cooked meatballs[**]

Sample codes	Hard	Cohe	Sprin	Gumm	Chew	Adhe
High fat (control)	11.57^{cd}	0.380^{c}	5.29^{bc}	4.32^{c}	23.07^{a}	0.018^{ad}
	(1.75)[*]	(0.03)	(0.35)	(0.56)	(2.90)	(0.03)
High fat + %0.5 CA[A]	10.01^{df}	0.318^{bc}	4.62^{ace}	3.18^{de}	14.83^{cefg}	0.187^{bd}
	(1.29)	(0.06)	(0.88)	(0.64)	(4.31)	(0.39)
High fat + %1 CA	9.45^{df}	0.294^{abd}	4.05^{a}	2.80^{bd}	12.32^{cf}	0.487^{c}
	(0.64)	(0.10)	(1.48)	(1.05)	(7.73)	(0.42)
High fat + %0.5 GG[A]	5.49^{a}	0.276^{ab}	4.47^{ad}	1.50^{a}	6.77^{b}	0.032^{d}
	(0.98)	(0.04)	(0.83)	(0.25)	(1.94)	(0.05)
High fat + %1 GG	4.69^{a}	0.239^{a}	4.54^{ae}	1.23^{a}	5.65^{b}	0.014^{d}
	(2.59)	(0.08)	(0.89)	(0.99)	(4.81)	(0.04)
Medium fat (control)	11.59^{cd}	0.353^{cd}	5.17^{be}	4.24^{c}	22.58^{a}	0.013^{ad}
	(3.46)	(0.09)	(0.80)	(1.91)	(10.87)	(0.03)
Medium fat + %0.5 CA	11.17^{cd}	0.331^{bc}	4.71^{ab}	3.74^{cd}	17.81^{ac}	0.005^{d}
	(3.21)	(0.03)	(0.37)	(1.26)	(6.87)	(0.02)
Medium fat + %1 CA	13.05^{ce}	0.357^{cd}	4.94^{e}	4.57^{c}	22.63^{a}	0.212^{ba}
	(3.24)	(0.08)	(0.13)	(1.08)	(5.46)	(0.33)
Medium fat + %0.5 GG	7.81^{bf}	0.324^{bc}	4.97^{e}	2.52^{be}	12.50^{cfg}	0.006^{d}
	(1.10)	(0.03)	(0.29)	(0.29)	(1.32)	(0.02)
Medium fat + %1 GG	6.13^{ab}	0.328^{bc}	4.58^{ace}	1.98^{ab}	9.17^{bf}	0.001^{d}
	(1.81)	(0.03)	(0.46)	(0.46)	(2.83)	(0.01)
Low fat (control)	10.23^{df}	0.354^{cd}	5.21^{be}	3.65^{cd}	19.32^{ae}	−0.005^{d}
	(1.97)	(0.07)	(0.41)	(1.04)	(6.77)	(0.01)
Low fat + %0.5 CA	10.57^{de}	0.351^{cd}	5.02^{e}	3.68^{cd}	18.37^{ag}	0.004^{d}
	(2.14)	(0.02)	(0.49)	(0.60)	(2.85)	(0.02)
Low fat + %1 CA	13.43^{c}	0.350^{cd}	4.85^{e}	4.52^{c}	22.16^{a}	0.231^{b}
	(2.93)	(0.11)	(0.28)	(1.03)	(6.34)	(0.33)
Low fat + %0.5 GG	7.91^{bf}	0.351^{cd}	5.49^{b}	2.78^{bd}	15.28^{ceg}	0.004^{d}
	(1.34)	(0.03)	(0.34)	(0.52)	(3.09)	(0.01)
Low fat + %1 GG	6.39^{ab}	0.299^{abd}	4.54^{ae}	1.94^{bd}	8.97^{be}	0.007^{ad}
	(2.35)	(0.04)	(0.34)	(0.82)	(4.15)	(0.02)

[A] CA = carrageenan; GG = guar gum.
[*] Standard deviation.
[**] Means with the same superscript are not different ($p > 0.05$).

certain that increased fat retention will improve texture. Bater, Descamps, and Maurer (1993) reported that addition of 0.5% κ-carrageenan to a restructured turkey meat significantly increased product yield.

Tables 5 and 6 show the effects of added gums and different fat levels on the textural properties of the raw and cooked meatballs. Fat had a highly significant effect on the textural properties of both raw and cooked meatballs. When fat level was decreased, hardness decreased in both raw and cooked meatballs. Carrageenan had a greater effect on the hardness of raw and cooked meatballs. Cooking led to an increase in hardness of the meatballs. Particularly, hardness of the low fat meatball, with the addition of 1% carrageenan after cooking, increased significantly ($p < 0.05$). Friction and/or binding among meat particles may be increased by adding carrageenan.

Fat and guar gum had the greatest effect on cohesiveness of raw meatballs in succession. A slight decrease was observed on the cohesiveness values; of cooked meatballs with the addition of guar gum, differences were not significant ($p > 0.05$) among cohesiveness of cooked meatballs with fat at the 15% and 10% levels.

Carrageenan showed a significant ($p < 0.05$) effect on gumminess of both raw and cooked meatballs with 10% fat content. Cooking led to an increase in the gumminess of the meatballs since the hardness of the meatballs after cooking significantly increased. Hughes, Mullen, and Troy (1998), reported a significant effect of fat on the cohesiveness and gumminess of frankfurters.

The chewiness of the raw meatballs increased with decrease in fat content. Cooking led to a dramatic increase in chewiness in the meatballs. Carrageenan showed a significant effect on the chewiness of the meatballs with 10% fat content. Desmond and Troy (1998) found that carrageenan improved overall texture of low fat beef burgers. Hsu and Chung (2001) reported that κ-carrageenan significantly increased hardness, chewiness and gumminess of the product.

Cooking had a small effect on springiness of meatballs. Guar gum significantly affected the springness of cooked meatballs with included fat at the 15% and 10% levels. When fat level was decreased, springiness increased in both raw and cooked meatballs. According to Rongrong, Carpenter, and Cheney (1998) less water would tend to increase hardness, springiness and cohesiveness, which supports the high valves seen in the

low-fat meatballs. While addition of 1% guar gum in the raw meatball formulation increased springiness, the springiness of cooked meatballs decreased with the addition of 1% guar gum.

Fat and guar gum had a highly significant ($p < 0.05$) effect on the adhesiveness of the raw meatballs in succession. Fat caused a decrease in adhesiveness of raw meatballs. Also, cooking led to decrease in adhesiveness of meatballs. Crehan, Hughes, Troy, and Buckley (2000) observed that fat reduction, from 30% to 12% or 5%, brought about a decrease in adhesiveness. Adhesiveness of cooked meatballs increased only with the addition of 1% carrageenan.

In conclusion, when water was added into low fat meatballs, it was observed that adding carrageenan improved water-binding (hence, yields) and texture.

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