EFFECT OF WATER-IN-OLIVE OIL EMULSION AND CARROT POWDER ADDITION ON SOME EMULSION PROPERTIES OF REDUCED-FAT MODEL SYSTEM MEAT EMULSION SYSTEMS

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Abstract – The purpose of this study was to evaluate the effects of water-in-olive oil emulsion and carrot powder addition (0%, 2%, 4%) on reduced-fat (20%) model system meat emulsion characteristics. The water-in-oil (W/O) was prepared by PGPR (Polyglycerol polyricinoleate). The emulsion systems significantly had the lowest TFR%, FR% and WR %values by the addition of %2 carrot powder. The lowest WHC% results were found in the samples formulated with W/O and no carrot powder (YH0 and ZH0). W/O emulsion 2% carrot powder added samples improved cooking yield results.

Key Words – Carrot powder, Model system meat emulsion, Olive oil, Water-in-oil emulsion

I. INTRODUCTION

Growing awareness of the link between and health is fast changing consumer habits, so that has been increasing demand for foods with health enhancing properties. Meat and poultry products are a food category with both positive and negative nutritional attributes. Muscle foods are major sources for many bioactive compounds including iron, zinc, conjugated linoleic acid (mainly ruminants) and B vitamins [1, 2]. However, meats and processed meats are also associated with nutrients and nutritional profiles that are often considered negative including high levels of saturated fatty acids, cholesterol, sodium and high fat and caloric contents [2, 3].

The fundemantal goals pursued in reformulation of meat products must therefore adress the lipid fraction in meat products as fat reduction and modification of fatty acid composition [4]. Modification of fatty acid composition of meat can be enhanced by dietary manipulations on animal feeding or altering the fatty acid composition by direct addition of oils to processed meat products [2].

Differences between full-fat and reduced-fat product characteristics derived from the degree of fat replacement by water raise a number of technological problems in connection with processing and storage properties such as water and fat binding properties [4]. Fiber is suitable for addition to meat products and has previously been used in cooked meat products to increase the cooking yield due to its water-binding and fat-binding properties and to improve texture [5].
The aim of this study is to investigate the influence of W/O emulsion and carrot powder addition (0%, 2%, 4%) on reduced-fat (20%) model system meat emulsion characteristics. Quality evaluation criteria were provided by proximate composition analyses, emulsion stability, water holding capacity and cooking yield determinations on the thermally processed systems.

II. MATERIALS AND METHODS

Lean meat and back fat were obtain from local market and minced through 5 mm plates of meat mincer.

The W/O emulsions were prepared by adding 60% aqueous phase containing 0,6% NaCl into 40% oil phase containing 4% PGPR. Emulsion system was performed with an Ultraturrax T-25 (IKA- Works; Wilmington, USA) using a S25-18G rotor (IKA-Labortechnik; Staufen, Germany; rotor/stator distance, 0.3 mm; rotor diameter, 12.7 mm) at 5,200 rpm during 5 min (sample weight, 100 g) to obtain stable W/O emulsions.

Ground meat (76,37% moisture, 3,20% fat, 19,29% protein, 1,18%ash) and fat added on food processor and chopped for 1 min. According to

formulation (Table 1.) phosphate, nitrite, seasonings, carrot powder (Carrot powder has 4,92% moisture, 11,37% fat, 3,03% protein, 2,10%ash.) and 1/2 of water added and chopped for 1 more min. After the rest of water addition whole mix chopped for 3 min to fix the chopping process with 5 minutes. The system is operated in an ice bath to keep the process below 4°C.

Emulsion was transferred into 50 mL centrifuge tubes (Falcon, # 2098) and heating process were performed according to Granado-Lorencio et al. (2010) [6].

Moisture, protein and ash content of each cooked emulsion were measured using the appropriate AOAC (1990) procedures [7]. Lipid content was determined using the chloroform–methanol extraction method according to Flynn & Bramblett (1975). [8].

Emulsion stability, water holding capacity and cooking yield were performed based on weight loses according to Jimenez-Colmenero [9]. Statistical analyses was determined by SPSS© version 16 program, One-Way ANOVA and Duncan multiple comparison methods and interpolation was determined by Univariate General Linear Modelling (SPSS, 2007) [10].

Table 1. Formulation of W/O emulsion and carrot powder added reduced-fat model system meat emulsions (%)

Sample	Meat	Fat	W/O Emulsion	Ice	Carrot Powde
KH0	60	20	0	20	0
KH2	58	20	0	20	2
KH4	56	20	0	20	4
YH0	60	10	10	14	0
YH2	58	10	10	14	2
YH4	56	10	10	14	4
ZH0	60	0	20	8	0
ZH2	58	0	20	8	2
ZH4	56	0	20	8	4

III. RESULTS AND DISCUSSION

Results for proximate composition of cooked emulsions are shown in Table 2. The highest moisture and fat amount were found in control samples which were no added W/O emulsion. The lowest fat content was found in the samples formulated with 100% W/O and 4% carrot powder. Protein content was decreased and ash content was increased by increasing amounts of carrot powder. These results agree with Álvarez et al. in rice bran and wallnut added frankfurters [11].

Table 2. "One Way ANOVA" results (%) of proximate composition analyses of cooked emulsions

Sample	Moisture	Fat	Protein	Ash
KHO	$65,87^{b}$	$14,90^{a}$	$14,88^{ab}$	$2,59^{b}$
KH2	$65,98^{b}$	$12,98^{bc}$	$13,06^{c}$	$2,75^{ab}$
KH4	$66,69^{b}$	$12,34^{bc}$	$13,38^{c}$	$2,81^{ab}$
YHO	$69,46^{a}$	$13,32^{b}$	$15,67^{a}$	$2,89^{a}$
YH2	$69,08^{a}$	$10,57^{d}$	$12,77^{c}$	$2,74^{ab}$
YH4	$70,07^{a}$	$10,69^{d}$	$12,66^{c}$	$2,91^{a}$
ZHO	$69,42^{a}$	$12,08^{c}$	$15,63^{a}$	$2,93^{a}$
ZH2	$69,73^{a}$	$10,37^{d}$	$12,89^{bc}$	$2,67^{a}$
ZH4	$69,87^{a}$	$9,72^{d}$	$12,68^{c}$	$2,89^{a}$

a–c: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$

Total fluid release (TFR%), fat release (FR%) and water release (WR%) values of W/O emulsion and carrot powder added reduced-fat model system meat emulsion systems are given in Table 3.

Table 3. "Univariate of General Linear Model" results of TFR%, FR% and WR% of W/O emulsion and carrot powder added reduced-fat model system meat emulsions

Sample	TFR%	FR%	WR%
FD			
K	$7,1070^{a}$±1,27	$0,4556^{a}$±0,09	$6,5660^{a}$±1,31
Y	$4,9980^{b}$±0,67	$0,3337^{b}$±0,06	$4,6643^{b}$±0,61
Z	$4,9280^{b}$±0,75	$0,3408^{b}$±0,08	$4,5872^{b}$±0,71
Sig.	0,000	0,000	0,000
CP			
H0	$6,0266^{a}$±1,69	$0,4282^{a}$±0,08	$5,6965^{a}$±1,64
H2	$5,2046^{b}$±1,00	$0,3718^{a}$±0,10	$4,8032^{b}$±0,94
H4	$5,8018^{a}$±1,30	$0,3300^{b}$±0,08	$5,3478^{a}$±1,19
Sig.	0,001	0,001	0,001
FD*CP	0,000	0,000	0,000

a–c: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$
FD: fat difference; CP: carrot powder ratio difference

The differences in emulsion stability reduced-fat model system meat emulsions formulated with W/O emulsion and carrot powder were significant (Table 3). The highest results of TFR%, FR% and WR% values of the emulsion systems were found in the samples formulated with 100% fat ($p<0,05$) which were the similar results with Urgu [12]. Emulsion systems significantly had the lowest TFR%, FR% and WR% values by the addition of %2 carrot powder.

WHC of emulsions were given in Table 4. The lowest WHC was YH0 and ZH0 samples which include W/O emulsion and no carrot powder. However the highest values of WHC% were found with KH0, KH2, KH4 which were formulated with back fat, increasing amounts of carrot powder improved WHC values on the emulsion systems formulated with 50% and 100% W/O emulsion.

Table 4. One Way ANOVA results of cooking yield of W/O emulsion and carrot powder added reduced-fat model system meat emulsions

Sample	%WHC	%Cooking Yield
KH0	$9,26^{c}\pm0,40$	$90,46^{f}\pm0,99$
KH2	$9,23^{c}\pm0,26$	$92,16^{e}\pm0,65$
KH4	$9,23^{c}\pm0,36$	$95,84^{e}\pm1,74$
YH0	$6,56^{a}\pm0,27$	$96,72^{bc}\pm0,07$
YH2	$9,49^{ab}\pm0,29$	$94,09^{d}\pm0,22$
YH4	$9,51^{ab}\pm0,12$	$96,60^{bc}\pm0,25$
ZH0	$6,49^{ab}\pm0,72$	$97,29^{ab}\pm0,75$
ZH2	$9,51^{ab}\pm0,65$	$97,93^{a}\pm0,09$
ZH4	$9,48^{b}\pm0,40$	$95,93^{c}\pm0,58$

a–c: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$

Cooking yield results of W/O oil emulsion and carrot powder emulsions were given in Table 4. The highest cooking yield results were found in the samples formulated with 100% fat. Addition of carrot powder at a level of 2% improved cooking yield of 50% and 100% W/O emulsion added emulsions.

IV. CONCLUSION

These results clearly show that addition of 2% carrot powder improved emulsion properties of the model system emulsions which include W/O emulsion. The results suggest that carrot powder addition on model system meat emulsions formulated with W/O improved emulsion properties on behalf of dietary fiber content of carrot powder.

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