EVALUATION OF SOME EMULSIFYING AGENTS IN PROCESSING OF EGYPTIAN FRNKFURTER

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INTRODUCTION:

Food emulsifiers play a major role in the production of uniform products with longer stability which can stand transport and storage *(Krogg, 1992)*,. In meat industry the selection of emulsifiers is limited to those generally "recognised as safe" or approved for food use and to those with the proper hydrophile-lipophile balance (HLB) for the product in question *(Akoh and Nwosn, 1992)*. The objectives of the present study were to compare between the chemical and physical properties of local licithin with some imported emulsifying agents i.e. panodan 150 and glyceral mono stearate, and to investigate their function on the fat and juice stability as well as other properties of Egyptian beef Frankfurters.

MATERIALS AND METHODS:

Beef Frankfurter Manufacture: The formula used in the production of beef frankfurter is presentd in Table (1). All ingredients (exceptice) were mixed together and then ground through a 1.25 cm plate. Each emulsifiers was added at the level of 0.3, 0.6 and 0.9% of the total meat mixture, then ice was added and the meat mixture was chopped in bowel cutter at 13°C. Emulsions were stuffed in 20-22m cellulose casings and smoked in smoking cabient (Fessman-Germany).

ANALYTICAL DETERMINATIONS:

Hydraphile-lipophile balance (HLB) of emulsifiers was calculated using the equation of Griffin (1965). Stability index (SI) was determined by the method of Titus et al., (1968). The chromatographic analysis of fatty acids of emulsifiers was performed according to Farag et al.,(1986), while the infra red spectra of emulsifiers were performed according to Farag et al.,(1977).

BEEF FRANKFURTER EVALUATION:

Emulsions stability of raw and smoked frnkfurters was determined by the method of Meyer et al.,(1964), and water holding capacity (WHC) and plasticity were determined using the method of Wierbicki and Deatherage, (1958). Finished frankfurter were cooked directly from the frozen state on electric hot plate at about 175°C for 4 min. The cooking loss percentage was calculated as follows:

Cooking loss = [Raw (weight) - Cooked (weight)] / [Raw weight x100]

PLATABILITY CHARACTERISTICS

A nine member of trained panelist evaluated the cooked product sample for colour, taste, odour, juicness and tenderness using eight point on Hedonic scale where 8 is the best an zero is the worst, according to the procedures of Cross et al., (1978).

STATISTICAL ANALYSIS

The obtained results of organoleptic evaluation were analyzed according to the method of Snendecor and Cochran (1980). Treatments mean were compared by the least significant difference (L.S.D) at the 5% level of probability.

RESULTS AND DISCUSSION

1- Physical and Chemical Properties of Emulsifiers:

1-1- Hydrophile-lipophile balance (HLB) and stability index (S.I.):

Emulsifiers studiedvaried in polarity over the entire HLB range (from 3.3 to 10.5) depending on their chemical composition (Table 2). Polarity of glycerol mono stearate is low (HLB:3.3). While polarity of local lecithin and panodan 150 are medium (HLB: 7.1 and 10.5). (Ebeler and Walker, 1984). Separation of oil from emulsions decrease as emulsifiers HLM increased at all concentration of emulsifiers investigated. The stability index have the same trends as it also increased with the increase of the soybean oil percentage. Glycerol mono stearate and local lecithin (stongly lipophilic) tended to make more stable water-in-oil emulsions in comparison with Panodan 150 (Strongly hydrophilic) (Akoh and Nwosu, 1992). Increasing the amount of emulsifiers caused and increase in the stability index of the emulsions at all levels of concentration (Table 2). These actions are attributed to the reduction of interfacial tension between the two phases of the emulsion (Cullum, 1992).

1-2- Fatty acids composition: Fatty acid contents of local lecithin, panodan 150 and glycerol non stearate were (55.5%, 3.3 and zero%) of unsaturated fatty acids and (44.5, 96.7 and 100%) of saturated fatty acids (Table 3). Oleic acid constitutes more than 86.0% of the total unsaturated fatty acids of local lecithin. However, stearic acid forms more than 75% and 68% of the fatty acids of panodan 150 and glycerol mono stearate

1-3- Infrared Spectra: The infarared specturm for lecithin revealed the presence of a peak at 5.8% corresponding to the ester carbonyl of the glycerophosphatide, and the presence of a peak at 10.3μ which is an indication for choline containing phospholipids. These peaks have been also reported by Pizzoli et al.,(1967) for soybean lecithin. The infrared spectrum also showed peaks at 6.8μ for bending (C-H, CH_2 and CH_3), at 8.1μ for (P=0), at 8.6μ for (COC) and 9.1μ for (P-O-). On the other hand, a peak at 9.2μ was also beleived to arise from (P-O-C) vibration and one at 8.2μ from a (C-O-C) linkage, (Marintte and Stote, 1953). Meanwhile, phosphatidyl ethanol amine and phosphatidyl serine of lecithin posses the fatty ester grouping which gives strong C=) bond (peak at about 5.7μ). These results are in agreement with those reported by Lang (1982) and Hurst and Martin (1986). The infrared spectrum of panodan 150 showed clearly the esters alcoholic, free OH group and carboxylic acids at peaks 2.8μ and 5.8μ. In infrared spectrum of glycerol mono stearate the peak at 2.8μ is attributed to the free OH-strectching. While, the peak at 5.8μ indicated the presence of carbonyl ester and the peak at 6.8μ is characterized for bending (C-H), (CH_2) and (CH_3).

2-BEEF FRANKFURTER EVALUATION:

2-1- Fat and Juice Stability:

Fat and juice stability (less rendering) increased in raw and smoked frankfurters containing emulsifiers compared to the control samples (Table 4). Panodan 150 has the best effect on fat and juice stability compared to other emulsifiers used even at high concentrations. Emulsifying action of glycerol mono strearate and local licithin was almost similar at the levels of 0.6 and 0.9% for raw and smoked frankfurter. While the action of parodan at the level of 0.9% was almost equivelent to the level of 0.3% of local licithin and glycerol mono stearate. The difference between emulsifiers is mainly due to the changes of HLB (Szuhaj, 1983), glycerol mono stearate (3.3), local licithin (7.1) and panodan 150 (10.5).

2-2- Water holding capacity (WHC) and cooking loss:

WHC and plasticity increased while cooking loss decreased with increasing the concentration of added emulsifiers (Table 4), indicating the increase ability of the system to bind more water and produce more stable emulsion. The highest increase in WHC and the lowest decrease in cooking loss was achieved by 0.9% glycerol mono stearate, followed by 0.9% of local licithin. Panodan, on the other hand seems to be non suitable for stabilizing this type of emulsion as it slightly affects WHC, plasticity and cooking loss of beef frankfurters (Table 4). Protein denaturation during smoking process might be the result in slightly decreaing WHC and plasticity of the system.

2-3- Palatability characteristics:

Neither emulsifier types nor concentrations had significant effect on frankfurter colour (Table 5), however a significant difference ($P<5\%$) was found between emulsified and unemulsified frankfurter in taste due to adding different emulsifier types, regardless of emulsifier concentrations. Optimum taste characteristic was observed when glycerol mono stearate was added to frankfurter. Emulsifier type and concentration had a significant effect ($P<5\%$) on frankfurter odour. Control samples and emulsified frankfurterh with glycerol mono stearate gave the highest scores for odour characteristic. It seems that glycerol mono stearate have no off odour and therefore, does not interfere with the typical odour of frankfurter, while on the other hand local lecithin might add some off flavour to the products. Regarding frankfurter juicness and tenderness, there was a significant ($P<5\%$) difference (Table 5) between emulsified and unemulsified frankfurters, regardless of emulsifier concentrations. Emulsified frankfurter with glycerol mono stearate and local lecithin gave the highest scores for juicness and tendeness characteristics. These results might be attributed to the changes in HLB values of emulsifiers and their role in reducing the rendering rate of fat and juice.

Table (1): Formula of beef frankfurter:

Ingredients	Beef frankfurter %	Ingredients	Beef frankfurter %	Ingredients	Beef frankfurter %
Beef lean	71.245	Ice	21.375	Starch	1.781
Salt (NaCl)	1.959	Sodium nitrate & Phosphate	0.356	Calcium caseinate	2.850
Ascorbic acid	0.025	Sodium mono glutameate		Garlic & onion poweder	0.092
Black papper	0.213				

Table (2) Stability index (S.I) of soybean oil-water emulsions with emulsifiers at different concentrations.

Emulsifier	HLB	%	% Soybean Oil 15	30	45	60	75	90
			Stability Index					
Local lecithin	7.1	1	12.20	13.50	94.70	101.10	98.50	99.40
		3	18.40	20.20	99.60	99.40	99.90	96.50
		5	19.60	20.90	99.10	99.10	99.50	100.80
Panodan 150	10.5	1	21.20	27.30	36.10	40.90	64.20	83.30
		3	36.10	62.00	92.80	95.30	96.00	97.10
		5	35.20	79.90	96.10	95.90	98.20	100.40
Glycerol monostearate	3.3	1	13.90	12.20	10.50	18.30	72.00	85.30
		3	59.30	84.10	95.40	99.10	99.60	102.00
		5	78.40	89.20	97.00	99.00	100.80	102.00

Table (4): Effect of emulsifiers on physical properties of raw and smoked frankfurter.

Emulsifier	Raw Frankfurter Rendered fat(ml)*	Rendered Juice (ml)*	WHC $(cm)^{2**}$	Plasticity $(cm)^{2**}$	Smoked Frankfurter Rendered fat (ml)*	WHC $(cm)^{2**}$	Plasticity $(cm)^{2**}$	Cooking loss (%)***
Control	3.2	2.8	2.65	4.55	1.2	4.60	3.55	3.22
Local lecithin								
0.3%	2.4	2.0	1.95	5.90	0.9	3.25	4.40	1.93
0.6%	2.0	1.2	1.40	6.20	0.7	2.70	4.70	1.83
0.9%	1.2	0.8	1.00	6.60	0.6	2.40	5.05	1.77
Panodan 150								
0.3%	3.2	2.8	2.35	5.00	1.1	4.00	3.85	2.58
0.6%	2.8	2.4	2.05	5.30	1.0	3.65	4.20	2.21
0.9%	2.4	2.4	1.80	5.70	0.8	3.30	4.60	2.19
Glycerol monostearate								
0.3%	2.0	1.6	1.70	6.05	0.8	3.10	4.45	1.93
0.6%	1.6	0.8	1.20	6.40	0.7	2.50	4.80	1.81
0.9%	1.2	0.8	0.80	6.80	0.5	2.20	5.20	1.61

* Values are calculated per 100 gr sample ** (cm^2) the greater aera indicates lower WHC and higher plasticity values.

*** Values are calculated as average of ten frankfurters (n = 10).

Table (3): Fatty acids composition of emulsifiers.

Emulsifier	Fatty acids %				
	C14:0	C16:0	C18:0	C18:1	C18:2
Local lecithin	3.47	17.89	23.13	47.82	7.69
Panodan 150	7.00	13.71	75.99	3.30	0.00
Glycerol mono stearate	29.47	2.45	68.08	0.00	0.00

Table (5): Organoleptic evaluation of frankfurter as affected by interaction between emulsifier and concentrations (mean scores)

Emulsifier	Organoleptic evaluation				
	Colour	Taste	Odour	Juicness	Tenderness
Control	7.30	7.80	7.90	7.30	7.10
Local lecithin					
0.3%	7.60	7.60	7.80	7.30	7.30
0.6%	7.30	7.40	6.90	7.00	7.10
0.9%	7.40	7.20	7.20	7.30	7.20
Panodan 150					
0.3%	7.50	7.30	7.10	6.70	6.90
0.6%	7.40	7.00	7.20	6.30	6.40
0.9%	7.80	6.90	7.00	7.00	6.90
Glycerol monostearate					
0.3%	7.90	8.10	8.00	7.70	7.60
0.6%	7.70	8.00	7.90	8.30	7.80
0.9%	7.50	7.90	7.50	7.50	7.80
Significant difference test A) Emulsifier types	NS	L.S.D.	L.S.D.	L.S.D.	L.S.D.
		0.367	0.380	0.410	0.363
B) Emulsifier concentrations	NS	NS	L.S.D.	NS	NS
			0.4391		
C) Interaction between AxB	NS	NS	NS	L.S.D.	NS
				0.821	

NS = Non signifcant

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