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CORN AND RICE EXTRUDATES SUPLEMENTED BY SPENT HEN MEAT

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ABSTRACT

In this study extrudate foods are produced with adding spent hen meat in different ratios (5, 10 and 15 %) in order to enhance protein content and nutritional value. The effect of the blended spent hen meat (SHM) with corn grits (CG) and rice grits (RG) on physical properties (breaking force, bulk density, expansion ratio, water solubility index and water absorption index); color parameters (lightness L^*,redness a^* and yellowness b^*) as well as sensory properties and scanning electron microscopy were studied. Corn extrudates had the highest breaking strength (BS) and water absorption index (WAI) but had the lowest bulk density (BD) and water solubility index (WSI) in comparable with RG extrudates. While bulk density (BD) showed continuous increases with the increase in SHM percentage, the BS, WAI and WSI recorded a negative relation. The redness (a^*) in all extrudate samples increased as the percentage of freeze dried SHM increase. However, the increment in blends means of CG is more than that of RG. Nevertheless, lightness (L^*) showed the opposite trend. Meanwhile, yellowness (b^*) of CG extrudates decreased with addition of SHM while with RG the reverse was true. Chewiness, taste, crispiness and total score quietly increased by addition of SHM in the rate of 5 or 10 % of blends while this addition did not exert any effect on sense of extrudate color and pores distribution. Raising the rate of SHM to be 15 % in the blends decreased the values of all sensory parameters and overall scores. Taste and odor of CG or RG extrudates seemed to be equal. Corn popped was superior in color while rice base extrudate superior in crispiness. Chewiness, surface characters and pores distribution were slightly different in the two base extrudates. Generally, SHM rates of 5 or 10 % did not show wide differences in L^*,$a^*$and b^*hunter, physical and sensory properties and in characters of scanning electron microscopy .

Keywords: Extrudates - Corn grits - Rice grits - Spent hen meat - Physical properties - Sensory properties - Scanning electron microscopy - Crude protein - Amino acids - Mineral status.

INTRODUCTION

Extrusion cooking has become a common processing method in the cereal, snack and vegetable protein industries for converting starchy and proteinaceous raw materials into fabricated products (Batistuti, *et al.* 1991; Avin, *et al.* 1992 and Alonso, *et al.* 2000). Snack foods tend to be high in calories and fat but low in protein, vitamins and nutrients (Ranhottra and Vetter, 1991).Extruded foods were produced with meat in combination with other ingredients. There have been a number of reports on production or characterization of expanded or non-expanded extrudates from blends of meat or fish and non-meat ingredients (Ba-jaber, *et al.* 1993; McKee, et al. 1995; Jean, *et al.* 1996; Rhee, *et al.* 1999a; Rhee, *et al.* 1999b and Mosha, *et al.* 2005).

The spend hen meat (SHM) is very tough in comparison to those of broilers and roasters due its higher collagen content, and is thus not well accepted by the consumers and this explain, although, it is a good source of protein but have minimal economic values (Lee, *et al.*, 2003).Therefore, it has been utilize primarily for chicken soups and emulsified chicken products such as frankfurter and bologna. Using SHM in producing extrudates may add a new economically importance to SHM'S utilization.

Physical and sensory properties of extrudates were affected pronouncedly by addition of protein sources as mentioned by many authors among of them Bhattacharya, *et al.* (1986) Park, *et al.* (1993), Rhee, *et al.* (1999b), Liu, *et al.* (2000), Lee, *et al.* (2003).and Obatolu, *et al.*(2005).

Color is important to attract consumers before they taste a product and fore visual observation as quality properties (Zasypkin and Lee, 1998). Color changes during the extrusion process can provide important information about the degree of thermal treatments and other processing treatments. Thus many authors conducted researches dealing with the color parameters and its responses to processing treatments and row materials used (Chen, *et al.* 1991; Konstance, *et al.* 1998; Lee, *et al.* 2003 and Murphy, *et al.* 2003).

Therefore, this investigation was conducted aiming to enhance the protein content and nutritional value of traditionally nutrient-poor extrudates using spent hen meat and in order to add new economical impotence to the spent hen meat to produce high quality extrudates with high nutritive value.

MATERIALS AND METHODS

MATERIALS

Raw materials

The yellow corn grits was obtained from Mass Food Company, 6*th* October City, Cairo, Egypt. Rice was purchased from local market, ground to get homogenous particles size by using a laboratory mill (Brabender Automat Mill Quandrumat Senior, Germany), then used to prepare different blends. Spent hens were slaughtered, plucked manually, cleaned and washed with water. The wings, necks, heads, skin and fat were removed manually, then debonded and cut to small pieces to facilitate mincing. The spent hen meat were minced twice using a meat grinder (Sanyo/meat grinder MG 2000, Sanyo electric Co. Ltd-Japan) and freeze dried using the Dura-Top/Dur-dry FTS system (USA) freeze drier. The dried material was ground and stored under -18 °C ± 2 until processing treatment.

Formulation of extrusion mixes

Freeze dried spent hen meat, corn grits, rice grits were mixed. These suggest.ed mixtures were used for preparation of extruded samples (Table 1).

Table (1) suggested mixtures.

Blends no. / Ingredient	1	2	3	4	5	6	7	8
Corn grits	100	95	90	85	-	-	-	-
Rice grits	-	-	-	-	100	95	90	85
Spent hen meat	-	5	10	15	-	5	10	15

METHODS

Extrusion process

A Brabender Laboratory Single-Screw extruder equipped with feeding device AE 300, speed control of the feeding device; temperature regulations for 2 extruder zones and die barrel head was used to prepare the extrudates. The barrel was divided into independent electrically heated zones (feed and cooking zones) cooled by air. A third zone, at the die barrel, also was electrically heated but cooled by water. The extrusion conditions were; temperature at cooking and die zones were adjusted together at 140 and 180 °C ,respectively. But, feed zone temperature was adjusted at 100 °C for all treatments; screw speed 250 rpm; screw composition 4:1 feeding screw speed 160 rpm and round die hole 3 mm. The resultant extrudates were allowed to reach room temperature. Expansion ratio and breaking strength measurements were made just after collecting the extrudates, then sealed in plastic bags and stored at room temperature until analysis.

Color

Color attributes; Lightness (L^*), redness (a^*) and yellowness (b^*) were evaluated using a Minolta Color Reader CR-10, Minolta Co. Ltd., Japan, according to Abd El-Hady *et al.* (2002)

Physical properties (Functional properties)

Expansion ratio (ER) was determined as the ratio of extruded product diameter and the diameter of the die hole. Values reported were means of ten measurements. The bulk density (BD) was determined as described by Moreyra and Peleg (1981). Breaking strength (BS) of the produced products was measured using Barebender Struct-O-graph fitted with a 500-cmg spring and a plexi glass beam. The beam travel speed was 9 mm minute ^-1. The peak height of the resultant recorded curves (as a Brabander units, Bu) for each sample was taken as texture measure. Values were reported as means of ten measurements as described by Abd El-Hady, *et al.* (1998). The water absorption (WAI) and water solubility (WSI) indices were measured by the method of Anderson, *et al.* (1969).

Chemical analysis

Ash, crude fiber and ether extract percentages were determined using the methods in A.O.A.C (1995). Nitrogen was determined using micro-Kjeldahel apparatus as mentioned in A.OA.C.(1995). Protein calculated by multiplying N % by the factor 6.25 as used by Tripathi, *et al.* (1971). Samples from every treatment product were collected, dried at 50 C and ground in a stainless steal mill. The digestion and mineral composition were determined according to AOAC (1995) by wet ashing and using Atomic absorption Spectrophotometer (Cottenie *et al.* 1982).

Amino acid composition of the extruded samples were determined as ug/ml according to More, *et al.* (1958) using Eppendorf amino acid analyzer with integrator, Germany.

Operating conditions were Flow rate:	0.2ml/min.
Pressure of buffer:	0 to 50 bar
Pressure of reagent:	0 to 150 bar
Reaction temperature:	123 °C

Sensory evaluation

The sensory evaluation of the extrudates included seven properties; which constitute the overall acceptability and carried out by staff members and semi-trained panelists for taste (20), crispeness (20), odor (15), chewiness (15), color (10), surface characteristics (10), pore distribution (10). The overall score of tested attributes (out of 100) and grades were given according to the following scale: excellent (86:100), good (76:85), fair (61:75) and poor (50:60) as described by Abu-Foul (1990).

Scanning electron microscopy

Scanning electron micrographs (SEM) were obtained by mounted the specimens on aluminum stubs and the sides of the mounting block covered with a layer of conductive graphite adhesive, The specimen sputter coated with gold (Si5oA- Sputtuer, Coater- Edwards-England, and examined under scanning electron microscope (Jeol-JXA. 840A Electron Probe Microanalyzer). (Jeol JSM-6100 Jeol ltd. Tokyo. Japan). An accelerating potential of 10 kv used during micrography.

Statistical analysis

Data subjected to the proper statistical analysis using the methods described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Proximate composition of raw materials

Data presented in Table (2) showed the proximate composition of raw materials. Spent hen meat was higher (especially in protein) than other materials in all composition. Corn and rice were low in fat, which adversely affected the popping performance. This data are in line with those obtained by Faubion and Hoseney, (1982) and Lee, *et al*., (2003).

Table (2): Proximate analysis (%) of ingredients.

Ingredients	Moisture	Crude protein	Ether extracts	Ash	Crude fiber
Spent hen meat	7.30	76.82	14.40	4.31	-----
Corn grits	11.18	6.78	0.52	0.57	0.57
Rice grits	11.04	6.32	0.55	0.41	0.32

Extrudates

Color

Color parameters of the extrudates were compared as an important feature of the product appearance and one from the main physical properts. Color is also an indicator of residence time, in the extruder and the intensity of the

Maillard reaction (Zasypkin and Lee, 1998). In addition, color is important to attract consumers before they test the product (Francis, 1991). Data illustrated in Table (3) demonstrated that means of lightness slightly lower, redness was higher and yellowness reached more about one fold in corn based extrudates over that of rice based extrudate. In Table (3) data also showed that the redness (a^*) of the extrudates increased as the percentage of freeze dried spent hen meat (SHM) increase, either it added to corn grits (CG) or rice grits (RG). However, the increment in rice grits blends were more than that of corn grits (Table 3). Nevertheless, the lightness (L^*) showed the opposite trends. Meanwhile, yellowness (b^*) decreased with addition of spent chicken meat while with rice the reverse was true. This phenomenon may be attributed to the yellow color of corn grits and light brown of the spent hen meat. The highest values of a^* was obtained by blends of rice grits containing 15 % SHM, however, the lowest in rice based extrudate only. Furthermore, the highest decrement in yellowness was amounted by 33.27 % with CG extrudate, nevertheless, the highest increment in this parameter (70.30 %) was in rice product when used the same SHM level. Bahttacharya, *et al.* (1986) found that higher L^* were obtained in blends containing of soy concentrate, whereas, blends containing higher corn gluten meal percentage had a higher b^* which is due to the presence of xanthophylls in corn. Rhee *et al.* (1999a) with ground meat (goat, lamb, mutton, spent hen meat and beef) addition and noticed that SHM treatment showed the highest L* values while extrudates with beef have the lowest because meat contains more heme pigments.

Table (3): Color properties as affected by adding spent hen meat to both corn and rice based extrudates.

Grits	Spent hen meat %	Lightness (L^*)	Redness (a^*)	Yellowness (b^*)
Corn	0	76.4	6.57	55.3
	5	75.4	7.20	46.7
	10	74.0	7.43	44.5
	15	70.1	7.37	36.9
	mean	73.95	7.14	45.85
Rice	0	78.5	3.40	16.5
	5	77.4	5.00	24.3
	10	77.4	5.83	26.3
	15	74.6	7.00	28.1
	Mean	76.98	5.31	23.80
Mean values of SHM	0	77.45	4.99	35.90
	5	76.40	6.10	35.50
	10	75.70	6.63	35.40
	15	72.35	7.19	32.50
L.S.D. at 5 % for:	G	1.01	0.30	0.82
	SHM	1.18	0.39	1.07
	G x SHM	N.S	0.56	1.51

SHM: Spent hen meat G: grits

Murphy, *et al.* (2003) measured color by hunter and revealed that L^*, a^* and b^* was not significantly affected by treatments variable (crab processing by-products;CB). However, within each product type, as the level of CB increased there was a strong trend for both L^* or b^* values to decrease. This slight color differences among treatments were anticipated owing to differences in fat composition and the intrinsic colors of the yellow corn meal and the light brown of CB. Using oats flour as a plant source for colorants, Liu, *et al.* (2000) pointed out that the redness of the extrudates was enhanced with the percentage of oat flour and this related higher redness of oats flour than corn flour. Moreover, with spent hen meat in popped cereal snacks blends, Lee, *et al.* (2003) indicated that popped snacks with no meat materials were higher in L^* than those with meat and grain, with rice flour show the higher value among samples. On the other hand, increasing meat content resulted in higher a^* and b^* values. This data are in harmony with our findings.

Physical properties (Functional properties)

Data presented in Table (4) reported that corn extrudates had the higher breaking strength (BS) and water absorption index (WAI) but the lower bulk density (BD) and water solubility index (WSI) means than rice extrudates. The differences in BS and WSI were significant. Park, *et al.* (1993) reported that high corn starch and low fat level resulted in the highest water absorption value. Abd El-Hady and Habiba (1996) confirmed this findings. Lee, *et al.* (2003) demonstrated that grains only popped snacks can show the lowest BD. Among popped snacks with meat and grains, meat with potato starch (1:2) had the lowest bulk density. They added that except for meat with rice, BD decreased gradually with increasing starch content.

While bulk density showed continuous increases with the increase in SHM percentage, the breaking strength (BS), water absorption index (WAI) and water solubility (WSI) recorded negative relations. Mixing SHM with the levels of 5, 10 and 15 % increased BD means by 23.92, 14.50 and 30.18 %, to the control, respectively. Regarding the relation between shear and water holding capacity (WHC), Bhattacharya, *et al.* (1986) observed the coefficients associated with the shear term and the response surface developed indicated that an increase in shear caused an increase in the WHC of the blends. They added that increasing shear caused structural alteration whereby the more hydrophilic sites were exposed allowing more water to migrate in. Lee, *et al.* (2003) observed that snacks from rice showed higher BF (Breaking force) than the other products while meat corn snacks showed the lowest BF at the ratio of 2:1. The lowest BF for meat-only snacks could be due to the higher level of lipids as well as muscle protein. In addition, as in Table (2), SHM contains relatively higher percentage of fat and this affected BF. This was supported by Bhattacharya, *et al.* (1986) who emphasized that the higher level of lipids reduced BF. Faubian and Hoseney (1982) demonstrated that the effect of lipids on the extrudate properties are complex and depend on type, amount, and hydrophilic-lipophylic balance of the lipid and the material being extruded. Lee, *et al.* (2003) supported these conclusions. Mohamed (1990) concluded that increase in the meat protein contents resulted in a decrease in expansion of corn starch extrudate.

Table (4): Physical properties as affected by adding spent hen meat to both corn and rice extrudates.

Grits	Spent hen meat %	Bulk density (g/ 100 cc)	Expansion ratio(ER)	Breaking strength (Bu)	Water absorption Index (WAI)gg-1	Water solubility index (WSI)%	Extruder torque (Nm)
Corn	0	38.39	3.49	520	9.00	21.09	15.30
	5	31.62	3.26	490	8.23	22.04	10.75
	10	38.32	2.92	496	8.11	20.29	9.35
	15	57.62	2.13	458	7.13	14.82	7.10
	mean	41.49	2.88	491	8.12	19.56	11.63
Rice	0	35.11	3.01	520	8.29	25.48	16.85
	5	59.46	2.81	497	7.99	26.68	14.90
	10	45.84	2.69	455	7.12	26.91	14.50
	15	38.04	2.36	353	7.36	23.17	14.10
	Mean	44.61	2.72	456	7.72	25.56	15.09
Mean values of SHM	0	36.75	3.25	520	8.70	23.29	16.08
	5	45.54	3.04	494	8.11	24.36	14.83
	10	42.08	2.82	476	7.62	23.60	11.93
	15	47.84	2.25	406	7.25	19.00	10.60
L.S.D. at 5 % for:	G	N.S	0.088	34.1	N.S	5.89	-----
	SHM	5.26	0.095	34.9	0.29	4.61	-----
	G x SHM	7.44	0.134	39.3	0.40	6.05	-----

SHM: Spent hen meat G: Grits Bu : Brabender unit

The increase in BD was 50.09 % in corn extrudate by addition of the higher level of SHM but it was 8.35 % in rice products enriched by 15 % SHM powder. The decrement in BS, WAI and WSI were 11.92, 20.78 and 29.73 %, respectively, when the SHM mixing level was 15 % in corn blends and were 32.12, 11.22 and 9.07 % with the higher level of SHM used in production of rice extrudates compared to that prepared from corn or rice grits solitary.

Concerning the expansion ratio, its means more in corn extrudates than the mean of RG extrudates. As the SHM content increase in the blends, the expansion ratio decrease in the extrudates and the differences were significant at 5% level. Furthermore, ER values of the control or that supplemented by different levels of corn extrudates were exceeded those with rice grits except the case of 15 % SHM addition the reverse was true. Mohamed (1990) concluded that increase in the meat protein contents resulted in a decrease in expansion of corn starch extrudates. Similar results have observed by other investigators: Clayton and Miscourides (1992), Gogoi, *et al.* (1996) and Giri and Bandyopadhyay (2000). Murphy, *et al.* (2003) observed the lower expansion with high crab–processing by-product concentration. It was proposed that protein enclosed available starch, thereby limiting its expansion. Moreover, Lee, *et al.* (2003) supported this phenomena which emphasized that lipids also affected the expansion of popped snacks. Increasing in meat content in the blends resulted in increases in lipid and protein contents and a decrease in the expansion of snacks occurred with increasing meat content. The inverse relationship between expansion ratio and bulk density was detected by Park, *et al.*(1993).

Sensory evaluation

Examination of sensory evaluation data in Table (5) revealed that taste and odor of corn or rice extrudates were seemed to be equal. Corn popped was superior in color while rice extrudates superior in crispeness. Surface characters, pore distribution and total score were slightly different with the two base extrudates. Moreover, regardless the spent hen meat addition, comparison of rice and corn extrudates showed that both approximately similar except in color which the color value of corn extrudates exceeded that of rice by 42.42 %. Booth (1990) concluded that snacks from corn frequently form adherent pasty aggregation around the teeth and influence consumer acceptance. Liu, *et al.* (2000) agree with this finding.

Concerning the effect of mixing of spent hen meat as shown in Table (5), data noticed that chewiness, taste, crispeness and total score quietly increased by adding SHM in the rate of 5 or 10 % of blends while this additions did not exert any effect on sense of extrudate color. Raised the rate of SHM to be 15% in the blends decreased the values of all sensory parameters and overall score means. The depression were 2.81, 17.25, 14.29, 10.26, 13.46, 25.43, 22.29 and 14.00% for taste, crispeness, odor, chewiness, color, surface character, pore distribution and total score, respectively. This data could be obviously demonstrated that fortified blends of extrudates by spent hen meat up to 10 % improved quality. On the opposite side, using 15 % SHM induced detectable negative effect on quality of the extrudate.

Addition of protein improved the sensory properties of corn extrudates as found by Skierkowski, *et al.*(1990), Bhattacharya (1997) and Abd El-Hady and Habiba (2003). In this point, Rhee *et al.* (1999) mentioned that, when sheep meat (lamb or mutton) is used with substantial amounts of non-meat ingredients in the manufacture of extruded products, the flavor problem may be overcome through interactions among constituents of the ingredients used, along with dilution of sheep meat by non-meat ingredients.

The interaction effects of starchy cereal base and SHM addition on sensory properties were recorded in Table (5). Data pointed out that the interaction affected significantly the all sensory properties except color parameter which the differences were non-significant. However, mixing of 15 % SHM with corn grits decreased taste, chewiness, and color values by: 15.66, 30.51 and 37.37 %, respectively. On reverse, it increased these criteria by 11.04, 10.34 and 28.07 % when rice base used in the blends. Crispiness, odor and total scores depressed by 37.79, 22.92 and 29.84 %, respectively, for the corn extrudates, however, it seemed without differences in rice base extrudates. Meanwhile, surface character and pores distribution decreased either by use corn or rice base by this treatment. The highest total score was produced by corn base extrudate with addition of 5 % (88.1%) followed by corn only (86.8%) and that enriched by 10 % (85.8 %) while in the case of rice base used the higher value of this character was mixed by 10 % SHM (84.7 %) followed by 5% (83.8). The lowest total score in both bases of extrudate, 60.9 % for corn base and 82.8 % when rice used as extrudate base at 15% S.H.M.

Table (5): Sensory properties as affected by adding spent hen meat to both corn and rice extrudates.
SHM: Spent hen meat   G: Grits

Grits	Spent hen meat %	Taste (20)	Crispeness (20)	Odor (15)	Chewiness (15)	Color (10)	Surface characteristics (10)	Pore distribution (10)	Total score 100	
Corn	0	16.6	17.2	14.4	11.8	9.9	8.6	8.3	86.8	Excellent
	5	17.8	17.2	13.9	13.4	8.7	8.4	8.7	88.1	Excellent
	10	17.1	17.9	13.1	12.8	7.9	8.3	8.7	85.8	Excellent
	15	14.0	10.7	11.1	8.2	6.2	5.1	5.6	60.9	Fair
	mean	16.38	15.75	13.13	11.55	8.18	7.60	7.83	80.42	Good
Rice	0	15.4	17.0	13.6	11.6	5.7	8.7	8.3	83.00	Good
	5	16.9	17.9	13.6	12.5	7.0	7.7	8.2	83.8	Good
	10	17.1	17.5	13.3	12.5	7.7	8.4	8.2	84.7	Good
	15	17.1	17.6	12.9	12.8	7.3	7.8	7.3	82.8	Good
	Mean	16.63	17.50	13.35	12.35	6.93	8.15	8.00	83.58	Good
Mean values of SHM	0	16.00	17.10	14.00	11.70	7.80	8.65	8.30	83.55	Good
	5	17.35	17.55	13.75	12.95	7.85	8.05	8.45	85.95	Excellent
	10	17.10	17.70	13.20	12.65	7.80	8.35	8.45	85.25	Excellent
	15	15.55	14.15	12.00	10.50	6.75	6.45	6.45	71.85	Fair
L.S.D. at 5 % for:	G	N.S	N.S	N.S	N.S	N.S	N.S	N.S	-	
	SHM	0.65	N.S	0.69	1.47	0.78	0.47	0.68	-	
	G x SHM	092	3.45	0.97	2.08	N.S	0.67	096	-	

Mineral and protein contents

It's obviously shown from data in Table (6) that rice based extrudate exceeded that of corn extrudates in N means and also intern in crude protein percentage. Also, P, K and Ca percentages were little higher.

A continuous increase was clearly observed in values of N, P and K by the increase in the SHM addition, meanwhile, Ca percentage slightly affected (Table 6).

It could be seen from data noted in Table (6) that supplementation of either corn or rice base with different rates of SHM increased the NPK content of extrudates.

Table (6): Minerals status as affected by adding spent hen meat to both corn and rice extrudates (%).

Grits	Spent hen meat %	N	P	K	Ca
Corn	0	0.52	0.150	0.10	0.050
	5	0.91	0.300	0.15	0.060
	10	0.96	0.270	0.19	0.059
	15	1.10	0.290	0.16	0.039
Mean		0.87	0.250	0.15	0.052
Rice	0	0.92	0.245	0.16	0.051
	5	0.77	0.315	0.12	0.051
	10	1.38	0.315	0.19	0.050
	15	1.82	0.365	0.33	0.070
Mean		1.22	0.310	0.20	0.056
Mean values of SHM	0	0.72	0.198	0.13	0.050
	5	0.84	0.308	0.14	0.056
	10	1.17	0.293	0.19	0.055
	15	1.46	0.328	0.25	0.055

**SHM: Spent hen meat *G: Grits

Generally, the highest rate of enrichment (15% SHM) increased N, P and K percentages by 111.54, 93.33 and 60.00 % with corn base, however, this increments amounted by 97.83, 48.98 and 106.25 % , respectively, compared to that prepared from corn or rice grits.

Table (7): Crude Protein percentages as affected by adding spent hen meat to both corn and rice grits based extrudates.

Grits	Spent hen meat				
	0	5 %	10 %	15 %	mean
Corn	4.72	5.69	6.00	6.88	5.82
Rice	5.75	4.81	8.63	11.38	7.64
Mean	5.24	5.25	7.32	9.13	

Amino acids

Data listed in Table (8) indicated that addition of the SHM at the rate of 10 % increased the total amino acids and essential amino acids in the profile of amino acids (ug/ml) in the extrudates compare to the un-received this supplementation. The increment caused with the fortification of rice grits by 10 % SHM is greater (about three folds) than that of corn grits fortified by the same percentage of SHM either for total or essential amino acids.

Table (8): Amino acids profile as affected by adding spent hen meat to both corn and rice grits based extrudates.

Amino acids ug/ml	Corn grits		Rice grits	
	Control	10 %SHM	Control	10 %SHM
Aspartic	175.09	244.23	161.458	313.38
Threonine	52.52	68.72	48.598	94.28
Serine	65.90	85.99	62.436	120.66
Glutamic	159.36	205.19	155.078	281.21
Proline	68.83	02.26	54.42	133.76
Glycine	57.84	73.06	54.384	102.83
Alanine	74.38	90.79	67.243	123.17
Valine	68.51	88.50	65.428	124.52
Methionine	9.85	9.67	12.133	0.38
Leucine	49.08	71.02	54.56	106.35
Isoleucine	91.37	116.91	87.175	160.42
Phenylalanine	42.10	52.22	39.314	67.17
Tyrosine	82.34	104.97	75.746	140.59
Histidine	41.24	48.54	37.191	66.87
Lysine	74.92	92.22	68.376	131.28
NH_4^+	180.40	246.59	152.845	284.04
Arginine	66.08	88.47	57.739	121.04
E.A.A.	470.69	604.23	451.33	824.99
T.A.A.	1179.41	1542.76	1101.28	2087.91

SHM: Spent hen meat E.A.A.: Essential amino acids T.A.A : Total amino acids

Scanning electron microscopy

Figures (1&2) show scanning electron micrographs of the extrudate samples under investigation. It was observed that the air cells were large in the extrudate samples containing corn (CG) or rice grits (RG) only, i.e. 100% CG or 100% RG (Figs.1&2).On the other hand, the air cells of the extrudate samples containing SHM were appeared smaller by increasing the rate of SHM addition (Figs 1&2). The air cells of extrudate samples with SHM were smaller than those with grain only CG or RG which indicates that starch content in the extrudate samples affects the production of air cells and the decrement in the expansion of the extrudate samples occurred with increasing spent hen meat content (Figs.1&2).

Therefore, the internal structure of the extrudate was affected by addition of spent hen meat rates. Bahattacharya, *et al.* (1986) with plant protein additives, revealed that an increase in shear rate gave a more hollow product while a low shear rate yielded to a denser product. However, with popped cereal snacks, Lee, *et al.* (2003) noticed increases in size and number of air cells and this intern signify that popping degree of the snack was high. Air size became smaller as meat contents increased. They added that the air cells of popped snacks with meat only were smaller than those with corn or potato starch.

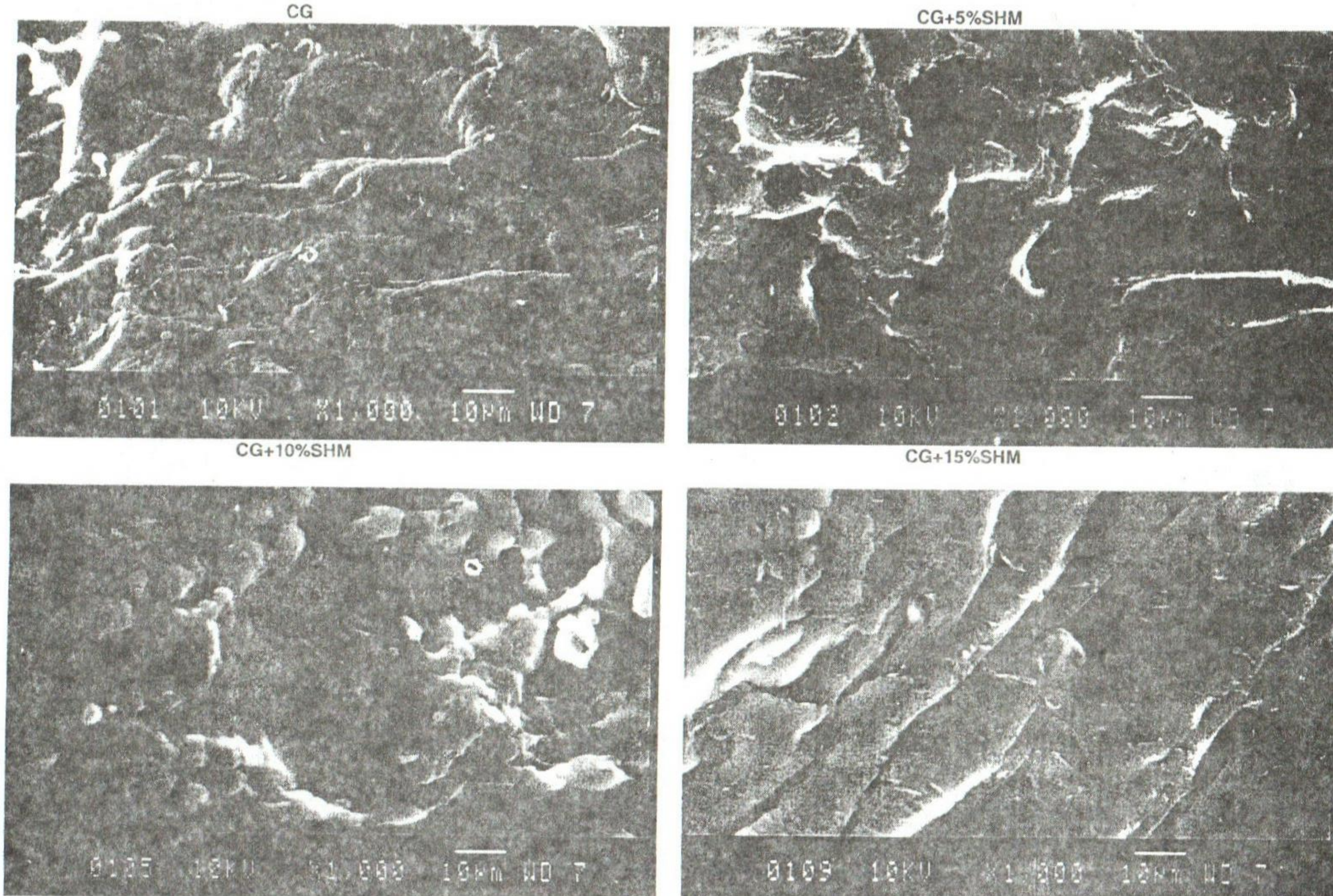

Fig.(1): Scanning electro- microscopy as affected by adding spent hen meat to corn grist based extrudes.

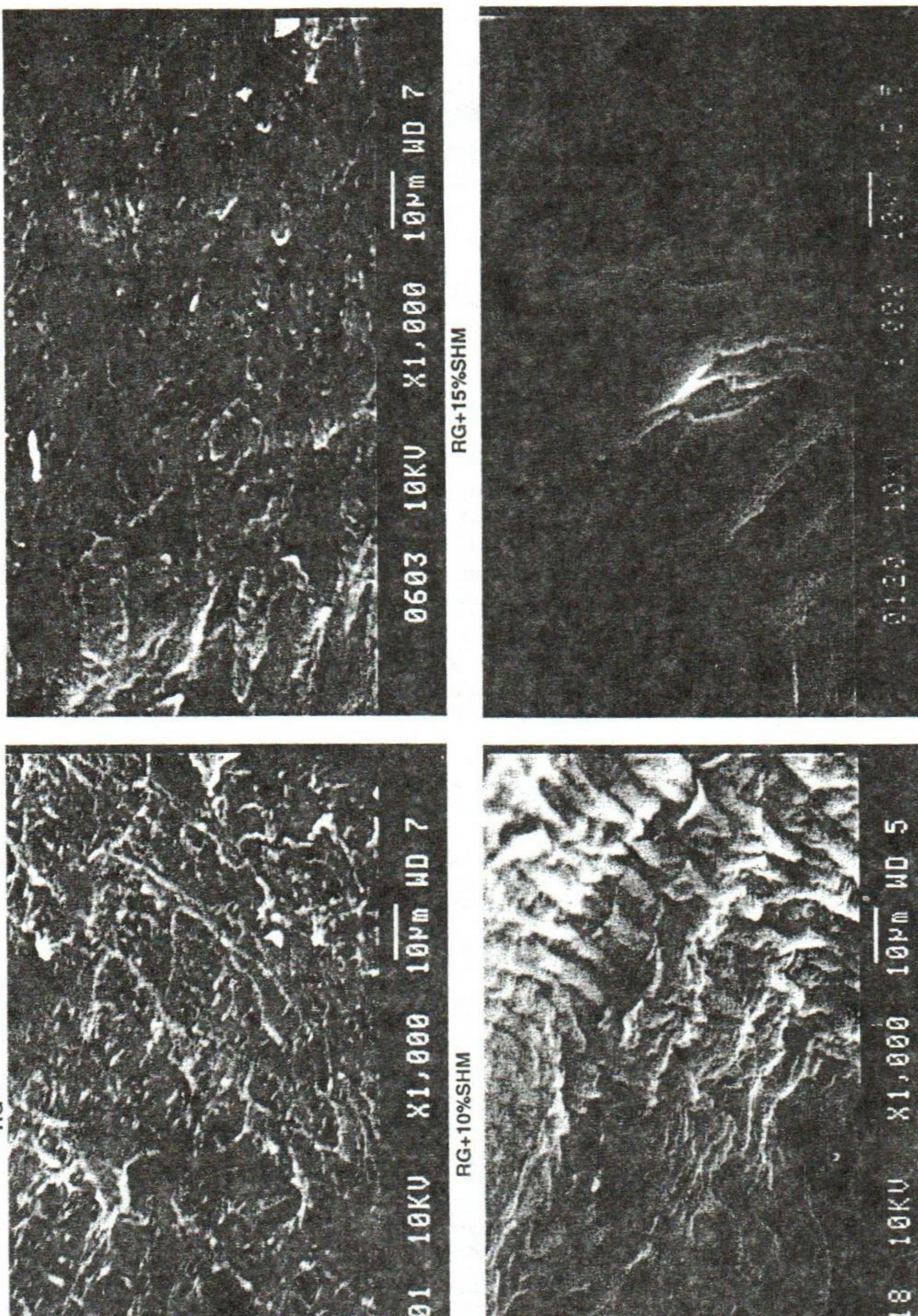

Fig.(2): Scanning electro- microscopy as affected by adding spent hen meat to rice grist based extrudes.

Conclusion

In order to improve the nutritional value of corn and rice grits as a base of extrudate, spent hen meat in the rate of 5, 10 and 15% were used. From the above-mentioned data it could be concluded that there are a possibility to fortified the extrudates by spent hen meat (as a source of animal protein) up to 10 % which did not showed negative effects in color and physical properties in addition to that it was acceptable from the point of view of sensory evaluation more than the improvement in mineral, crude protein, total amino acids and total essential amino acids contents (Tables6-8) but this needed further researches.

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مبثوقات الذرة والأرز المدعمة بلحم جدود الدجاج

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يهدف هذا البحث الى دراسة تأثير اضافة لحم جدود الدجاج المجفد بنسب مختلفة (صفر، ٥، ١٠، ١٥ %) لزيادة المحتوى البروتينى والقيمة الغذائية للمنتج مع دراسة تأثيرهذة الأضافات على الصفات الطبيعية والحسية والمحتوى المعدنى وخصائص قطاعات الميكروسكوب الأليكترونى لمبثوقات الذرة والأرز. وكانت أهم النتائج هى:

١- تميزت مبثوقات الذرة بارتفاع قوة الكسرو معدل الذوبان فى الماء عن مبثوقات الأرز.

٢- أظهرت الكثافه الكليه زيادة مستمرة الا أن قوة الكسر ومعدل امتصاص الماء ومعدل الذوبان فى الماء اظهرت استجابة سالبة مع الزيادة فى نسبة اضافة لحم جدود الدجاج.

٣- ازدادت درجة كل من احمرار المنتج ولمعانه بزيادة نسبة اضافه لحم الدجاج بينما أظهرت درجة الأصفرار انخفاضا فى حالة مبثوقات الذرة وارتفاعا فى حالة مبثوقات الأرز مع زيادة نسب لحم جدود الدجاج.

٤- زادت درجة القابليه للمضغ والطعم والهشاشية باضافة لحم جدود الدجاج بنسبة ٥ – ١٠ % بينما لم تؤثر هذة الأضافة على توزيع المسام واللون. صفات الطعم والرائحة فىالمنتجين تكاد تكون متساوية.

٥ – ارتفاع نسبة الأضافة الى ١٥ % أدى الى نقصا ملموسا فى جميع الصفات الحسية لكلا النوعين من المبثوقات.

٦ – تحسن مستوى النتروجين والبروتين وكذلك البوتاسيوم والفسفورمع اضافة لحم جدود الدجاج المجفد.