Quality Characteristics Of Catfish Flesh (*Clarias Gariepinus)* As Influnced By Partial Replacement Of Fish Meal Protein With Poultry By-Producut Meal Protein

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ABSTRACT

Twelve samples of African catfish were obtained monthly from earthen ponds (12 x 400 m^2) which stocked with African catfish *Clarias gariepinus* fingerlings (average mean 40.07±1.12 g/fish and at a rate of 4000 fingerlings/pond) to evaluate its flesh quality as measured by chemical; physical; microbiological and sensory methods. These fish were fed with three practical diets (4 ponds for each) (25% protein), (0%) (D0), 35% (D35) and 70% (D70) replacement of fish meal protein by poultry by-product meal protein, for ~1 year. Immediately, fish samples washed carefully and kept in deep freezer at −18 °C till used in quality attributes analysis. Total volatile basic nitrogen (TVBN), Thiobarbituric acid (TBA) and also, pH were determined. Microbiological and sensory methods were conducted on the flesh of the tested fish.

The results revealed that the TVBN values of D70 was higher than that for the other treatments in the end of the experiment but there were no significant difference in TVBN for both D0 and D35. It could be noticed that TBA values of all treatments were significantly increased during May, Jun, July and August. In the same time it could be noticed that the TBA value of D0 was lower than that of D35 and D70 but the three values were in the limit of a good quality fish. pH values of D0 did not change significantly ($P<0.05$) during the culture period, while, pH values of both D35 and D70 were gradually increased during the culture period reached 6.67 and 6.94 for both D35 and D70, respectively.

The D70 had a higher significant increase in both total bacterial count ($P<0.05$; 49500 Cfu/g) and total yeast count (7.72 x 10^2 Cfu/g) when compared with D0 and D35. However there was a slightly increase in total mold count of D35 and D70 at the end of the study reached to 34 and 140 Cfu/g, respectively. It could be concluded that the replacement of fish meal protein by poultry by-product meal protein increased both total bacterial and yeast count.

Generally, a positive correlation coefficient (r) was 0.41, 0.39, 0.42 and 0.41) for TVBN, pH, total bacterial count and total yeast count, with treatment, respectively. On the other hand, a negative correlation (r=0.39) was TBA with treatment.

Kaywords: catfish, quality, microbiological, chemical, sensory analysis.

INTRODUCTION

The consumer's acceptance of fishery products depends on several attributes of food quality. Important attributes of food are safety, nutrition, flavor, texture, color and appearance and the suitability of raw material for processing and preservation. In addition to interspecies variation, intraspecific factors markedly influence these attributes. The fish farmer has some control of physiological factors, such as biological age and growth rate; environmental factors, such as water temperature, pressure, flow and chemistry and dietary factors such as feeding cycle, starvation, overfeeding, and the presence or absence of specific components *(1)*.

Fish not only serves as the major source of animal protein in many developing countries, but can also compete on the world markets with red meats, poultry, and dairy products. To be successful the seafood must satisfy the demand of the consumer in respect to sensory quality, nutritional value *(2)*.

Unlike other animal products, quality of fish is more difficult to control due to variations in species, sex, age, habitats and action of autolytic enzymes as well as hydrolytic enzymes of microorganisms on the fish muscle. Aquaculture operations demand precise control of water quality such as pH, oxygen demand, salinity, presence of phytoplankton etc., and the use of appropriate feed formulations for optimal yield of the fish species *(3)*.

This investigation was aimed to study the effects of long term replacement of fish meal protein by poultry by-product meal protein with different levels, on the quality characteristics of African catfish *Clarias gariepinus* flesh. Evaluation was carried out by chemical; physical; microbiological and sensory methods.

MATERIALS AND METHODS

This work was carried out from Oct. to Aug. 2003, also, it was a complementary part for the investigation which was conducted by, *(4)*.

Twelve fish samples of were obtained monthly from earthen ponds (12 x 400 m^2) which stocked with African catfish "*C. gariepinus* fingerlings" (average 40.07±1.12 g/fish and at a rate of 4000 fingerlings/pond). These ponds were classified into three groups (4 ponds each). The first, second and third group fed normal fish diet replaced by 0, 35 and 70% poultry by-product protein diet respectively.

Fish samples were immediately were washed carefully with tab water and filleted, the obtained fillets were kept in deep freezer at –18°C till use in quality attributes analysis.

Technological Methods:

Two fish products were prepared :

A- African catfish finger:

Catfish fillets were minced three times through 4.5 mm plate and mixed with garlic 1%, cumin 1% and black pepper 0.8% then, it was shaped as fingers then frozen at -18 °C. The frozen fingers were immersed in soft dough. The dough consists of corn flour 94%, egg yolk 2%, skim milk 2% and sodium chloride salt 2% in water with ratio of 2 : 3 respectively then, the fingers were immediately coated by powdered Rusk and stored at -18 °C. The frozen fingers were fried in cotton seed oil (deep frying) for 3 min. and evaluated organolepticaly.

B- Smoked catfish fillets:

The fillets were brined by soaking for 48 hours in 24% sodium chloride solution at 5 °C, desalted by in tab water for 4 hr., and dried for 20 hours in direct sunlight. Cold smoking (traditionally, in smoke-house) at 40 ° C for 12 hr. Using citrus wood saw-dust as a source of smoke.

Methods of quality characteristics evaluation:

Fish flesh was subjected to chemical, physical and microbiological investigations

chemical methods

Total volatile basis nitrogen *(5)* and Thiobarbituric acid *(6)* were determined.

Physical methods

The pH was assessed using a pH meter on a homogenate which consisted of 5g of fish sample in 50 ml of distilled water, *(7)*.

Microbiological methods

Total bacterial count *(8)* and total mold and yeast counts *(9)* were determined.

Sensory evaluations

Samples used in this investigation were organoleptically tested for their appearance, flavor, texture and overall acceptability *(10)*. Sensory evaluation of each treatment was carried out after processing by a panel of 10 Judges numerical system and grading system (table 1).

Table 1: Numerical and grading systems used for sensory evaluation *(10)*.

Numerical system	Order	Excellent	V.good	Good	Acceptable	Bad	V.bad
	Value	8.5-10.0	7.5-8	6.5-7	5.0-6.0	4.5-5	<4.5
Grading system	Grade	Fancy	V.good	Medium	Standered	Substandered	
	Least score%	90	80	70	60	50	

N.B. Less than 50% score is rejected

Statistical analysis

All data were computed and submitted to analysis of variance (ANOVA), in one way analysis of variance *(11)* among treatments within the same month and among different months within the same treatment-, and, also, correlation coefficient (r) was calculated, *(12)*. Program software (Version 8) at a significance level 5% was used.

RESULTS AND DISCUSSION

The effect of replacement of fish meal protein by poultry by-product at different ratio on total volatile basis nitrogen (TVBN) mg N/100g of tested African catfish flesh provided in Table 2. It is obvious from the aforementioned results that initial TVBN of African catfish flesh was 4.20 mg N/100g and there was an increase in all TVBN for all treatment after 1 month reached 4.69, 5.12 and 4.44 mg N/100g for D0, D35 and D70 respectively, whereas the TVBN values were significantly decrease in November, December, Feb. and March in all treatments which may be due to the low temperature in these months, inducing a decline of bacterial and enzymes activities *(13)*. While these values started to increase from May to August reached 6.06, 6.36 and 9.23 mg N/100g, for D0, D35 and D70 respectively. It could be concluded from the same results that the TVBN values of D70 was higher than that for the other treatments at the end of the experiment but there was no significant difference in TVBN for both D0 and D35. Generally, fish is considered fresh if TVBN value is less than 15 mg N/100g , *(14)*.

Table 2: Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on TVBN (mg/100g).

Time of sampling	Total volatile basis nitrogen (TVBN) (mg/100g ± SE)		
	Treatment		
	D_0	D_{35}	D_{70}
Initial	4.20 ± 0.00 Ha	4.20 ± 0.00 Fa	4.20 ± 0.00 Ja
October	4.69 ± 0.01 EFb	5.12 ± 0.10 Ca	4.44 ± 0.02 Ic
November	4.41 ± 0.01 GHb	4.39 ± 0.03 DEFb	4.93 ± 0.03 GHa
December	4.34 ± 0.02 GHb	4.32 ± 0.02 EFb	4.82 ± 0.02 Ha
January	4.37 ± 0.01 GHb	4.36 ± 0.03 EFb	4.85 ± 0.02 GHa
February	4.48 ± 0.04 FGb	4.44 ± 0.04 DEFb	5.04 ± 0.06 Ga
March	4.64 ± 0.04 EFb	4.49 ± 0.04 DEFb	5.74 ± 0.10 Fa
April	4.86 ± 0.08 DEb	4.55 ± 0.04 DEc	6.68 ± 0.02 Ea
May	5.06 ± 0.12 Db	4.68 ± 0.05 Dc	6.80 ± 0.04 Da
June	5.40 ± 0.14 Cb	5.02 ± 0.09 Cc	7.25 ± 0.08 Ca
July	5.74 ± 0.11 Bb	5.44 ± 0.18 Bb	7.81 ± 0.08 Ba
August	6.06 ± 0.12 Ab	6.36 ± 0.24 Ab	9.23 ± 0.13 Aa

*D_0 , D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

*Different capital letter indicate that there are significant difference among months, but the other indicate that there are significant difference among treatments

Changes in thiobarbituric acid (TBA) values with different replacement levels represented in table 3, it could be noticed that the initial TBA value was 0.10 mg malonaldehyde/kg fish and this value was increased in all treatments after one month of the culture period reached 0.146, 0.132 and 0.114 mg malonaldehyde/kg fish for D0, D35 and D70, respectively, while the TBA values of all treatments were reduced in Nov., Jan. and Feb. Otherwise, it could be noticed that TBA values of all treatments were significantly increased during May, Jun, July and August which may be attributed to the high temperature in these months, which accelerating the bacterial and enzymes activities, ***(15)***.

In the same time it could be noticed that the TBA value of D0 was lower than that of D35 and D70 but the three treatments were in a good quality as fish and fish products are of good quality when having less than 2 mg malonaldehyde/kg ***(16)***.

Table 3: Effect of partial replacement of fish meal with poultry by-product meal in practical diet of African catfish flesh (*C. gariepinus*) reared in earthen ponds on thiobarbituric acid (TBA) (mg/kg.)

Time of sampling	Thiobarbituric acid (TBA) (mg/kg ± SE)		
	Treatment		
	D_0	D_{35}	D_{70}
Initial	0.100 ± 0.00 Ga	0.100± 0.00 Ha	0.100 ± 0.00 Ga
October	0.146± 0.001 Ea	0.132± 0.001 FGb	0.114 ± 0.001 Fc
November	0.139 ± 0.001 EFa	0.131± 0.002 FGb	0.112 ± 0.001 FGc
December	0.131 ± 0.002 Fa	0.128± 0.002 Ga	0.108 ± 0.002 Gb
January	0.132 ± 0.002 Fa	0.129± 0.002 Ga	0.116 ± 0.003 Fb
February	0.142 ± 0.005 EFa	0.135± 0.002 FGab	0.124 ± 0.003 Eb
March	0.148 ± 0.007 Ea	0.138± 0.002 EFab	0.128 ± 0.003 Eb
April	0.164 ± 0.004 Da	0.143± 0.003 DEb	0.134 ± 0.002 Db
May	0.179 ± 0.01 Ca	0.148± 0.003 Db	0.139 ± 0.001 CDb
June	0.187± 0.01 Ca	0.161± 0.003 Cb	0.143 ± 0.001 Cc
July	0.199 ± 0.004 Ba	0.170± 0.01 Bb	0.157 ± 0.002 Bc
August	0.212 ± 0.005 Aa	0.191± 0.001 Ab	0.182 ± 0.001 Ab

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

*Different capital letter indicate that there are significant difference among months, but the other indicate that there are significant difference among treatments

The pH of the fish meat may give valuable information about its condition measurements. Variations in pH values of African catfish flesh due to replacement of fish meal protein by poultry by - products are tabulated in Table 4. The tabulated results indicated that the initial pH value of all treatments was 6.41. From same results it is clear that the pH value of D0 did not change significantly during the culture period. However the pH values of D35 and D70 were gradually increased during the culture period reached 6.67 and 6.94 for both D35 and D70, respectively. At the end of the culture period

Table 4: Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on pH value.

Time of sampling	pH value		
	Treatment		
	D_0	D_{35}	D_{70}
Initial	6.41 ± 0.00 Aa	6.41 ± 0.00 Ia	6.41 ± 0.00 Ca
October	6.43 ± 0.01 Ac	6.51 ± 0.01 Hb	6.56 ± 0.02 BCa
November	6.43 ± 0.01 Ac	6.52 ± 0.01 GHb	6.58 ± 0.01 BCa
December	6.44 ± 0.009 Ac	6.53 ± 0.012 GHb	6.60 ± 0.01 BCa
January	6.45 ± 0.015 Ac	6.54 ± 0.019 FGHb	6.60 ± 0.01 BCa
February	5.96 ± 0.49 Ba	6.56 ± 0.01 EFGa	6.62 ± 0.01 BCa
March	6.48 ± 0.02 Ac	6.58 ± 0.01 DEFb	6.64 ± 0.02 Ba
April	6.49 ± 0.013 Ac	6.58 ± 0.018 CDEb	6.67 ± 0.034 Ba
May	6.53 ± 0.02 Ac	6.60 ± 0.02 BCDb	6.67 ± 0.01 Ba
June	6.53 ± 0.01 Ac	6.62 ± 0.01 BCb	6.69 ± 0.02 Ba
July	6.55 ± 0.01 Ac	6.63 ± 0.01 Bb	6.71 ± 0.01 Ba
August	6.57 ± 0.01 Aa	6.67 ± 0.016 Aa	6.94 ± 0.22 Aa

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

*Different capital letter indicate that there are significant difference among months, but the other indicate that there are significant difference among treatments

The results summarized in table 5 showed the total bacterial count of tested fish flesh as affected by replacement of fish meal by poultry by-product in different ratios (0, 35, and 70%). From the aforementioned results it could be observed that the initial total bacterial count of all treatments were 130 Cfu/g and there was a non significant increase after one month in Oct. in all treatments reached 158, 210 and 3100 Cfu/g for D0, D35 and D70, respectively, while in Nov., till April there was slightly increase in total bacterial count of all treatments. However, a significant increase was noticed during period from May to Aug. reached 3000, 14500 and 49500 Cfu/g, for D0, D35 and D70, respectively. These results are in agreement with previous works *(13, 17)*. Fish is considered fresh if the number of the microbe colonies less than 10^4, *(14)*.

It could be, also, noticed that there were no significant differences between D0 and D35, while, the D70 had a significant increase (49500 Cfu/g) when compared with the other treatments.

The results tabulated in table 6 represent the total yeast count indicating that the initial yeast count for all treatments were <100 whereas there was a slightly increase during the study period which were 372, 440 and 772 cfu/g at the end of the study for D0, D35 and D70, respectively. The total yeast count of D70 treatment was the highest value (772 cfu/g) when compared with the other treatments.

Table 5: Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on the total bacterial count cfu/g

Time of sampling	Total bacterial count cfu/g Treatment		
	D_0	D_{35}	D_{70}
Initial	130 ± 0.00 Fa	130 ± 0.00 Ca	130 ± 0.00 Ea
October	158 ± 9 EFb	210 ± 15 Cb	3100 ± 91 EDa
November	143 ± 8 EFb	197 ± 17 Cb	2925 ± 85 EDa
December	140 ± 15 EFb	195 ± 14 Cb	3075 ± 315 EDa
January	155 ± 53 EFb	208 ± 11 Cb	3050 ± 236 EDa
February	243 ± 53 EFb	228 ± 14 Cb	4450 ± 523 EDa
March	370 ± 49 Eb	1318 ± 898 Cb	6300 ± 687 EDa
April	645 ± 24 Dc	1680 ± 1082 Cb	7300 ± 925 EDa
May	830 ± 35 CDb	2905 ± 2006 BCb	10050 ± 870 CDa
June	993 ± 77 Cb	5500 ± 1675 BCb	16100 ± 3964 Ca
July	2175 ± 217 Bb	9275 ± 3740 ABb	27750 ± 5779 Ba
August	3000 ± 41 Ab	14500 ± 5847 Ab	49500 ± 5635 Aa

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

*Different capital letter indicate that there are significant difference among months, but the other indicate that there are significant difference among treatments

Table 6:Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on the total yeast count cfu/g.

Time of sampling	Total yeast count cfu/g Treatment		
	D_0	D_{35}	D_{70}
Initial	90 ± 0.00 Da	90 ± 0.00 Fa	90 ± 0.00 Ia
October	90 ± 0.00 Db	90 ± 0.00 Fa	137 ± 6.50 HIa
November	90 ± 0.00 Db	92 ± 2.50 Fb	137 ± 4.80 HIa
December	90 ± 0.00 Db	92 ± 2.50 Fb	152 ± 12.50 Gha
January	90 ± 0.00 Db	92 ± 2.50 Fb	187 ± 13.10 FGa
February	97 ± 7.50 Db	107 ± 6.30 Fb	220 ± 10.80 Efa
March	95 ± 2.90 Dc	132 ± 13.10 Efb	260 ± 14.70 Ea
April	112 ± 14.36 Dc	175 ± 15.50 Deb	332.5 ± 23.20 Da
May	155 ± 32.00 CD b	200 ± 21.20 CD b	370 ± 17.80 Da
June	210 ± 37.60 BCb	242 ± 31.20 Cb	442 23.20 Ca
July	255 ± 42.10 Bb	310 ± 10.80 Bb	587 ± 27.50 Ba
August	372 ± 49.70 Ab	440 ± 60.60 Ab	772 ± 10.30 Aa

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

*Different capital letter indicate that there are significant difference among months, but the other indicate that there are significant difference among treatments

Table 7 showed the total mold count of African catfish flesh as affected by replacement of fish meal by poultry by-product. The results cleared that the initial total mold count was <10 cfu/g for all treatment and had a constant value in D0 treatment till the end of the study. However there was an increase in total mold of D35 and D70 at the end of the experiment reached 34 and 140 cfu/g, respectively.

Table 7:Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on the total mold count CFU/g.

Time of sampling	Total mold yeast cfu/g		
	Treatment		
	D_0	D_{35}	D_{70}
Initial	9	9	90
October	9	9	90
November	9	9	90
December	9	9	90
January	9	9	90
February	9	9	90
March	9	9	90
April	9	9	90
May	9	9	100
June	9	9	105
July	9	9	115
August	9	34	140

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

Table 8: Effect of partial replacement of fish meal with poultry by-product meal in practical diets of African catfish flesh (*C. gariepinus*) reared in earthen ponds on sensory properties of smoked catfish and catfish fingerlings

Properties	Smoked catfish fillets			African catfish fingerlings		
	D_0	D_{35}	D_{70}	D_0	D_{35}	D_{70}
Color	7.00	6.50	6.10	8.80	8.50	8.00
Flavor	8.30	7.80	7.50	8.60	8.40	8.70
Texture	6.40	5.90	5.50	8.70	8.40	8.50
Appearance	7.80	6.90	7.10	8.60	8.50	8.50
Overall acceptability	81.94	75.28	72.78	96.39	93.88	93.61

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

Organoleptic score values for color, flavor, appearance, texture and overall acceptability for catfish fingers, and smoked catfish fillets which manufactured from different treatments of African catfish flesh were given in Table 8. It could be observed that the overall acceptability of smoked fillets processed from D0 and D35 treatments had higher values according to the sensory evaluation given in Table 8 which were 81.9 and 80.6, respectively, followed by D70 which was 72.8. Sensory evaluation results of fish finger manufactured from catfish flesh treatment are also tabulated in Table 8 and it could be noticed that fish finger processed from D0 and D70 treatment had a higher value in overall acceptability which were 96.4 and 94.4, respectively this means fancy grade according to the sensory method followed D70 which was 89.4.

From the above results it could be mentioned that using D35 treatment in feeding did not cause any quality loss for African catfish and it was almost similar to D0.

Table 9: Growth performance of *C. gariepinus* cultured in earthen ponds (400 m^2) as a mono-culture system at a rate of 10 fingerlings/m^3 and fed with three different replaced diets with of animal protein for 12 months.

Item	Treatment		
	D_0	D_{35}	D_{70}
Initial body weight (g/fish)	47.84 ± 11.13 A	38.13 ± 1.47 A	42.32 ± 1.36 A
Final body weight (g/fish)	224.02 ± 10.09 A	237.61 ± 7.41 A	236.35 ± 2.95 A
Total harvest (kg/pond)	580.70 ± 18.87 B	697.93 ± 28.33 A	666.95 ± 33.16 AB
Specific growth rate (g/fish/day %)	1.43 ± 0.03 A	1.47 ± 0.01 A	1.46 ± 0.01 A

*D_0, D_{35}, and D_{70} are diet with no, 35% and 70% replacement of fish diet protein by poultry by-product meal protein respectively .

A, B. Values-having different letter at the same raw are significantly ($P<0.05$) different.

In addition, as showed in table 9 using D35 as partial replacement of diet protein raised both total harvest and specific growth rate of African catfish during the culture period. Similar result has been recorded previously *(4)* where total harvest was 580.7, 697.93 and 666.95 Kg /pond for D0, D35 and D70, respectively, while, specific growth rate was 1.43, 147 and 1.46 g/fish/day percent for D0, D35 and D70, respectively. Generally, there was a positive correlation (r values = 0.41, 0.39, 042 and 0.41) between the treatment (diet)and TVBN, pH, total bacterial count and tota yeast count, respectively. On the other hand, a negative correlation (r = 0.39) was observed between the treatment and TBA.

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الملخص العربى

خصائص الجودة لسمكة القرموط الافريقى المرباة فى احواض ترابية و تأثرها بالاستبدال الجزئى لبروتين عليقة الاسماك ببروتين عليقة مخلفات مجازر الدواجن

صفوت عبد الغنى جمعة - اميرة ابراهيم على الحنفى

المعمل المركزى لبحوث الثروة السمكية-مركز البحوث الزراعية. مصر

تم تجميع اثنتا عشرة عينة من أسماك القرموط الإفريقي شهريا من أحوض ترابية (١٢×٤٠٠) م٢ و التى تمت تغذيتها بثلاث علائق مختلفة كالآتي صفر% (د صفر) ، ٣٥% (د ٣٥)، و ٧٠% (د ٧٠) استبدال لبروتن العليقة (٢٥% بروتين) ببروتين عليقة من مخلفات مجازر الدواجن و ذلك لمدة عام تقريبا.

و ذلك لقياس مؤشرات الجودة في لحومها بالطرق الكيماوية و الفيزيقية و الميكروبيولوجية و الحسية.أجريت عملية الغسيل للأسماك بعناية و بسرعة ثم تم تجهيز الشرائح يدويا و حفظت بالتجميد على - ١٨ °م لحين جراء اختبارات الجودة.

تم قياس قيمة القواعد النيتروجينية الطيارة، و قيمة حمض الثيوباربيتيوريك و كذلك رقم الأس الهيدروجيني و تم كذلك إجراء الاختبارات الميكروبيولوجية و الحسية.

و أتضح من النتائج المتحصل عليها أن قيمة القواعد النيتروجينية للمعاملة د ٧٠ كانت أعلى من باقي المعاملات في نهاية التجربة و لم توجد اى اختلافات معنوية بين د صفر ، د ٣٥ ومن الملاحظ أن قيمة حمض الثيوباربيتيوريك لجميع المعاملات كانت تزداد معنويا في الشهور مايو وحتى أغسطس و في نفس الوقت نشاهد أن قيمة حمض الثيوباربيتيوريك للمعاملة د صفر كان اقل من المعاملات د ٣٥، د ٧٠ و لكن الثلاث قيم كانت في المدى المحدد للسمك الطازج من اسماك المياة العذبة.

وجد أن قيمة الأس الهيدروجيني للمعاملة د صفر لم تتغير معنويا أثناء فترة التجربة بينما زادت قيمة الأس الهيدروجيني للعينات د ٣٥ ، د ٧٠ تدريجيا.

و كان العد الكلى للبكتريا و العد الكلى للخمائر للمعاملة د ٧٠ أعلى معنويا بمقارنتها بالمعاملات د صفر ، د ٣٥. بينما كانت هناك زيادة طفيفة في عدد الفطريات الكلى للمعاملات د ٣٥ ، د ٧٠ في نهاية فترة التجربة.

و قد اتضح من النتائج أن استبدال بروتين العليقة ببروتين عليقة مخلفات مجازر الدواجن أدى إلى زيادة كل من العدد الكلى البكتيري و أعداد الخمائر و أيضا بزيادة نسبة الاستبدال يزداد العدد الميكروبي وكان هناك معامل ارتباط ايجابي بين القواعد النيتروجينية الطيارة و رقم الأس الهيدروجيني و العدد الكلى للبكتريا و العدد الكلى للخمائر و المعاملات بينما كان هناك معامل ارتباط سلبى مع حمض الثيوباربيتيوريك و المعاملات. أوضحت النتائج أن أفضل نسبة استبدال كانت ٣٥% حيث أنها كانت قريبة من ضابط التجربة (د صفر).