CHANGES IN SELECTED CHEMICAL, MICROBIOLOGICAL AND SENSORY QUALITY CHARACTERISTICS OF COMMON CARP (*CYPRINUS CARPIO* L.) BLOCKS DURING FROZEN STORAGE

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Abstract

The comparative quality and frozen stability (-20°) of common carp (*Cyprinus carpio* L.) Fillet and machine minced flesh blocks packaged in ice-glaze film or polyethylene bags were evaluated over a

6-months period. Results showed that, the chemical indices of freshness and the bacterial count (TBC and PsBC) showed slightly increasing trends in all treatments, but fillets blocks were had much more stability than minced block, specially those which were packaged in ice-glaze film compared with those packaged in polyethylene bags. This corresponded to the slightly decrease in sensory evaluation for all samples, while fillet blocks were much more desirable than minced blocks, specially, those fillet blocks packaged in ice-glaze film.

INTRODUCTION

Freezing is an important method of fish preservation, however, there is progressive deterioration in sensory and other properties during storage due to changes in lipids and proteins. Functional and textural characteristics of meat depend mainly on myofibrillar proteins. The mincing of fish muscle tissue does, however, have its advantages among which is the ability to make use of species with low commercial value (Pastoriza *et al.* 1994).

Measurement of sensory, chemical and physical changes have shown that deterioration of fish quality continues to some extent during frozen storage (Haard, 1992). Lowering of fish quality during frozen storage has been attributed to undesirable changes associated with lipids and proteins (Abdalla *et al.*, 1989). Changes in lipid occur through hydrolysis and oxidation mechanisms (Haard, 1992). Fish muscle proteins can undergo denaturation during frozen storage due to formation of ice crystals resulting in hydration, increase in salt concentration and pH changes following the removal of water through ice formation (Le-Blanck *et al.*, 1988).

Both chemical analysis and visual examination indicated that the quality of albacore tuna was acceptable after 12 months frozen storage, particularly –25°C (Ben-Gigirey and De-Sousa, 1999). Results indicated that mince should be stored for no longer than 3 days at 0 or 5ºC to maintain optimal quality. Frozen mince with cryoprotectant would remain acceptable for ≥ 3 months at –20ºC (Suvanich *et al.*, 2000-a). Blocks composed of minced flesh have the potential for use in the preparation of new seafood products favouring a minced flesh form. The frozen stability of minced flesh would be important in establishing its reliability as a raw material.

This investigation was designed to evaluate the comparative frozen stability of common carp blocks composed of fillets or minced flesh during frozen storage. This could help to determine and predict the commercial quality of the fish.

MATERIALS AND METHODS

Samples and experimental design

Sample lots of round fish common carp (*Cyprinus carpio* L.) were immediately obtained after catching from Abbassa fish farm at Sharkia governorate, Egypt. Intact flesh was separated by hand filleting and was obtained from thoroughly washed, eviscerated and beheaded, minced a half of lots flesh. Fillets and minced flesh were placed in 3×10×20 cm. stainless steel trays and frozen into blocks at –30ºC for twelve hours. The blocks were removed from the freezer and a half of fillets and minced flesh blocks were ice glazed and received two replicate short exposures to ice water allowing for approximately one hour at –30ºC between exposures. All treatments: 1- fillets blocks packaged in ice-glazed film., 2- fillets blocks packaged in polyethylene bags., 3- minced blocks packaged in ice- glazed film., 4- minced blocks were packaged in polyethylene bags, and stored at –20ºC. Sensory evaluations, microbiological count and chemical analysis were carried out at 0, 1, 2, 3, 4, 5 and 6 months storage.

At the end of every freezing period (30 days), samples were withdrawn at random, aseptically thawed at room temperature, cut into small pieces, mixed and chopped in electric meat chopper and were then analyzed. All analysis were run in triplicate.

Analytical methods

Total volatile bases nitrogen (TVBN), and Trimethylamine nitrogen (TMAN) were determined according to the method recommended by the AMC (1979). Thiobarbituric acid (TBA): was measured according to the method described by Tarlagis *et al.* (1960). Peroxid value (PV) was determined according to the standard titration method (AOAC, 1990). Total bacterial count (TBC) was detected according to the method described by Frazier and Foster (1959) and Psychrophilic bacterial count (PsBC) was detected according to the method described by Sharf (1966). Organoleptic evaluation samples which were organoleptically evaluated for juiciness and appearance every month during storage. A group of 10 jadges were always called upon for scoring the organolyptic properties of the various samples were fried in deep-corn oil for 5 minutes at 176°C, by giving grades ranging from zero to 10 according to Teeny and miyauchi (1972) as estimated by the following scheme:

Score	Description	Score	Description
10	Ideal	4	Fair
9	Excellent	3	Poorly fair
8	Very good	2	Poor
7	Good	1	Very poor
6	Fairly good	0	Repulsive
5	Acceptable		

Statistical Analysis

Three replications of each trial were performed TVBN, TMAN, TBA, PV, TBC, PsBC and sensory data were analyzed using ANOVA and means were separated by Duncan at a probability level of < 0.05 (SAS, 2000).

RESULTS AND DISCUSSION

Total volatile bases nitrogen TVBN and Trimethylamine nitrogen TMAN (mg / 100g) of common carp fillets and minced blocks packaged in ice-glaze film and polyethylene bags, during storage at –20°C for 6-months are shown in Tables 1 & 2. Results showed that the highest content in TVBN and TMAN was recorded in minced blocks packaged in polyethylene bags, while, the lowest contents in TVBN and TMAN was found in fillets blocks packaged ice-glaze film. The aforementioned results, indicated that, during the period of storage, a significantly slowly increase ($P < 0.05$) in TVBN and TMAN started with 15.2 and 1.21 (mg /100g) at the first time of storage, respectively, and reached to 17.1, 17.8, 18.3 and 19.2 (mg /100 g) for TVBN, and 1.71, 1.79, 1.84 and 1.94 (mg /100g) for TMAN for fillets blocks packaged in ice-glaze film, polyethylene bags; minced blocks packaged in ice-glaze and polyethylene bags, respectively.

The increment in TVBN and TMAN during storage at –20°C could be resulted from the decomposition and degradation of nitrogen substances which may be due to the activity of microorganisms. These results coincided with those given by Ben-Gigirey and De-Sousa (1999), Boknaes *et al.* (2000), Gokoglu *et al.* (2000) and Suvanich *et al.* (2000-a).

Regarding thiobarbituric acid (TBA) and peroxide value (PV), Table 3 and 4 in dicated significantly a gradual increase ($P < 0.05$) in TBA and PV contents in all samples up to the end of storage period, however, the increment rate was higher in minced blocks packaged in polyethylene bags. The TBA-values recorded the value of 0.81(mg Malonaldehyde/ kg) at zero time, while, at the end of storage period were 2.13, 2.55, 2.36 and 2.85 (mg Malonaldehyde/ kg) for fillets blocks of common carp packaged in ice-glaze film, polyethylene bags; minced blocks packaged in ice-glaze film and polyethylene bags, respectively.

Respecting the peroxide value, results shown recorded in table 4 showed significant increase in PV observed up to 6 months of storage period. Accordingly, all block samples PV started with 16.1 (meq. peroxide/ Kg fat) at zero time of storage at –20°C, reached to 27.7, 28.8, 29.4 and 30.7 (meq. peroxide/ Kg fat) to fillets blocks packaged in ice-glaze film, polyethylene bags; minced blocks in ice-glaze film and polyethylene bag after 6-months of storage, respectively.

Additionally, from the foregoing results, the increment in TBA and PV during storage could be resulted from lipid oxidation. These results are in harmony with those obtained by Aubourg and Medina (1999); Ben-Gigirey and De-Sousa (1999) and Undeland and Lingnert (1999).

Microbiological evaluation

Table 5 illustrated the changes in total bacterial count TBC (Log 10 CFU/g) of common carp frame fillets and minced packaged in ice-glaze film and polyethylene bags during storage at –20°C. The highest level of TBC was observed in minced packaged in polyethylene bags compared with the other treatments at the end of storage period. However, the results showed significant decrease ($P < 0.05$) in TBC in all samples up to 6 months of storage.

On the other side, changes in psychrophilic bacterial count PsBC (Log 10 CFC/ g.) during storage at –20°C for common carp fillets and minced packaged in ice-glaze film or polyethylene bags are shown in Table 6 . Results indicated that, the count of PsBC increased with the progress of storage time. A sharp increase was observed after 90 days of storage in all samples, after which, a gradual increase was indicated till the 180 days of storage. The fresh samples recorded 4.48 (Log 10 CFU/g) at the beginning of storage period. Although, the count of psychrophilic bacteria increased by storage, count for fillets packaged in ice-glaze film and polyethylene bags were 4.85 and 5.15 (Log 10 CFU/g), respectively, when compared with samples of minced packaged in the same system being 5.08 and 5.26 (Log 10 CFU/g), respectively.

Generally, the reduction in numbers of microorganisms as indicated previously may be due to the mechanical damage of bacterial cell caused by freezing and thawing on the microflora contaminating flesh fish samples. However, the psycrophilic bacteria gave high values on the progress of storage period which may suggest the presence of psychrophilic spore forming bacteria which are again activated by freezing. These results are in line with those obtained by, Boknaes *et al.* (2000) and Suvanich *et al.* (2000-b).

Organoleptic evaluation

The achived results presented in Tables 7 and 8 showed the effect of storage period at –20°C on juiciness and appearance,. The analysis of juiciness and appearance grades, indicated that the scores were significantly higher ($p<0.05$) in fillets blocks packaged in ice-glaze film at –20°C (8.0) at the end of 6 months of storage and followed in order by the fillets blocks packaged in polyethylene bags (7.2), minced blocks packaged in ice-glaze (7.0) and in polyethylene bags (6.8), respectively. These results may be attributed to the rate of moisture loss and bound water of the samples during the frozen storage. These results are in agreement with those obtained by Nilsson and Ekstrand (1995), Boknaes *et al.* (2000) and Gokoglu *et al.* (2000).

From the above investigation, the obtained results showed that the intact fillets blocks packaged in ice-glaze can possess good quality during storage period at –20°C for 6-months compared with quality charachteristics in fillets blocks packaged in polyethylene bags and minced blocks packaged in ice-glaze film or polyethylene bags stored at the same temperature (-20°C) for 180 day.

Table 1. Total volatile bases nitrogen (TVBN) levels (mg / 100g) in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at –20°C for 6 months.

Parameter		TVBN (mg / 100g)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 15.2 ± 0.05 CD	a 15.2 ± 0.07 D	a 15.2 ± 0.06 D	a 15.2 ± 0.07 D
	1	a 15.2 ± 0.03 CD	a 15.4 ± 0.05 CD	a 15.4 ± 0.03 D	a 15.6 ± 0.01 D
	2	ab 15.5 ± 0.04 C	ab 15.7 ± 0.07 C	ab 15.8 ± 0.04 CD	a 16.1 ± 0.05 C
	3	b 15.9 ± 0.06 BC	Ab 16.1 ± 0.01 BC	ab 16.3 ± 0.05 C	a 16.7 ± 0.03 C
	4	ab 16.2 ± 0.01 B	ab 16.5 ± 0.04 B	ab 16.8 ± 0.07 BC	a 17.5 ± 0.06 B
	5	c 16.6 ± 0.02 B	b 17.1 ± 0.06 B	b 17.4 ± 0.01 B	a 18.2 ± 0.04 AB
	6	c 17.1 ± 0.04 A	c 17.8 ± 0.02 A	b 18.3 ± 0.07 A	a 19.2 ± 0.05 A

a-c Means within a raw with the same superscript are significantly different ($p<0.05$).
A-D Means within a column with the same superscript are significantly different ($p<0.05$).

Table 2. Trimethylamine nitrogen (TMAN) levels (mg / 100g) in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at –20°C for 6 months.

Parameter		TMAN (mg / 100g)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 1.21 ± 0.03 D	a 1.21 ± 0.04 D	a 1.21 ± 0.06 E	a 1.21 ± 0.05 E
	1	b 1.21 ± 0.04 D	ab 1.25 ± 0.01 D	ab 1.26 ± 0.05 E	a 1.33 ± 0.03 D
	2	c 1.28 ± 0.02 CD	b 1.32 ± 0.05 CD	b 1.35 ± 0.03 D	a 1.42 ± 0.07 CD
	3	b 1.38 ± 0.05CD	ab 1.42 ± 0.01 C	ab 1.46 ± 0.03 C	a 1.52 ± 0.01 C
	4	ab 1.45 ± 0.01 BC	a 1.55 ± 0.06 BC	a 1.57 ± 0.02 BC	a 1.59 ± 0.04 C
	5	c 1.57 ± 0.06 AB	b 1.64 ± 0.05 AB	ab 1.69 ± 0.02 B	a 1.73 ± 0.02 B
	6	b 1.71 ± 0.03 A	ab 1.79 ± 0.03 A	ab 1.84 ± 0.05 A	a 1.94 ± 0.06 A

a-c Means within a raw with the same superscript are significantly different ($p<0.05$).
A-D Means within a column with the same superscript are significantly different ($p<0.05$).

Table 3. Thiobarbituric acid (TBA) levels (mg. malonaldehyde / Kg) in common carp fillets and minced blocks, packaged in iceglaze film or polyethylene bags during storage at –20°C for 6 months.

Parameter		TBA (mg. malonaldehyde / Kg)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 0.81 ± 0.01 C	a 0.81 ± 0.01 C	a 0.81 ± 0.01 C	a 0.81 ± 0.02 C
	1	ab 0.92 ± 0.02 C	a 0.97 ± 0.04 C	a 0.95 ± 0.03 C	a 0.99 ± 0.04 BC
	2	ab 1.06 ± 0.03 BC	a 1.18 ± 0.03 B	ab 1.12 ± 0.01 B	a 1.2 ± 0.02 B
	3	d 1.26 ± 0.01 B	b 1.41 ± 0.01 B	c 1.32 ± 0.01 B	a 1.51 ± 0.01 B
	4	b 1.49 ± 0.03 B	ab 1.69 ± 0.01 B	b 1.57 ± 0.01 B	a 1.83 ± 0.02 AB
	5	c 1.77 ± 0.01 AB	a 2.04 ± 0.02 A	ab 1.92 ± 0.03 AB	a 2.2 ± 0.01 A
	6	b 2.13 ± 0.01 A	a 2.55 ± 0.01 A	ab 2.36 ± 0.02 A	a 2.85 ± 0.01 A

a-d Means within a raw with the same superscript are significantly different ($p<0.05$).
A-C Means within a column with the same superscript are significantly different ($p<0.05$).

Table 4. Peroxide value (PV) levels (milliequivalents peroxide / Kg of lipid) in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at –20°C for 6 months.

Parameter		P.V. (milliequivalents peroxide / Kg lipid)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 16.1 ± 0.01 E	a 16.1 ± 0.02 E	a 16.1 ± 0.01 E	a 16.1 ± 0.02 F
	1	b 16.5 ± 0.03 E	ab 17.0 ± 0.04 DE	a 17.03 ± 0.05 DE	a 17.6 ± 0.06 E
	2	c 17.1 ± 0.01 DE	b 18.5 ± 0.01 DE	b 18.8 ± 0.02 D	a 19.3 ± 0.01 D
	3	c 19.7 ± 0.02 CD	b 20.3 ± 0.01 CD	b 20.5 ± 0.01 C	a 21.2 ± 0.02 C
	4	c 21.8 ± 0.01 BC	b 22.4 ± 0.03 BC	d 20.5 ± 0.01 C	a 23.7 ± 0.02 BC
	5	bc 24.9 ± 0.01 B	b 25.3 ± 0.02 B	c 24.0 ± 0.02 B	a 26.6 ± 0.02 B
	6	d 27.7 ± 0.03 A	c 28.8 ± 0.01 A	b 29.4 ± 0.01 A	a 30.7 ± 0.05 A

a-d Means within a raw with the same superscript are significantly different ($p<0.05$).
A-F Means within a column with the same superscript are significantly different ($p<0.05$).

Table 5. Total bacterial count (TBC) levels (Log 10 CFU / g.) in common carp fillets and minced blocks,packaged in ice-glaze film or olyethylene bags during storage at –20°C for 6 months.

Parameter		T.B.C. (Log 10 CFU / g.)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethy lene	Ice-glaze	Polyethy lene
Storage period (Months)	0	a 5.58 ± 0.01 A	a 5.58 ± 0.01 A	a 5.58 ± 0.01 A	a 5.58 ± 0.03 A
	1	b 5.49 ± 0.02 A	ab 5.51 ± 0.03 AB	a 5.51 ± 0.01 AB	a 5.53 ± 0.03 A
	2	b 5.41 ± 0.02 B	a 5.45 ± 0.02 AB	a 5.46 ± 0.02 AB	a 5.49 ± 0.02 A
	3	b 5.34 ± 0.01 B	ab 5.4 ± 0.01 B	ab 5.41 ± 0.01 AB	a 5.48 ± 0.02 AB
	4	c 5.28 ± 0.03 C	b 5.34 ± 0.01 B	b 5.38 ± 0.01 B	a 5.46 ± 0.01 AB
	5	c 5.02 ± 0.02 D	bc 5.3 ± 0.01 B	b 5.36 ± 0.02 B	a 5.46 ± 0.02 AB
	6	d 5.18 ± 0.01 D	c 5.28 ± 0.03 C	b 5.32 ± 0.03 B	a 5.43 ± 0.01 AB

a-d Means within a raw with the same superscript are significantly different ($p<0.05$).

A-D Means within a column with the same superscript are significantly different ($p<0.05$).

Table 6. Psychrophylic bacterial count (PsBC) levels (Log 10 CFU / g.) in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at –20°C for 6 months.

Parameter		Ps.B.C. (Log 10 CFU / g.)			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethy lene	Ice-glaze	Polyethy lene
Storage period (Months)	0	a 4.48 ± 0.01 D	a 4.48 ± 0.01 DE	a 4.48 ± 0.01 E	a 4.48 ± 0.01 E
	1	c 4.48 ± 0.01 D	b 4.54 ± 0.02 D	b 4.54 ± 0.01 D	a 4.6 ± 0.02 D
	2	c 4.6 ± 0.02 CD	c 4.65 ± 0.01 CD	b 4.72 ± 0.03 C	a 4.81 ± 0.01 C
	3	c 4.63 ± 0.01 C	b 4.72 ± 0.01 C	b 4.79 ± 0.02 C	a 4.93 ± 0.01 BC
	4	c 4.71 ± 0.03 BC	b 4.81 ± 0.01 B	ab 4.88 ± 0.01 BC	a 5.02 ± 0.03 B
	5	c 4.81 ± 0.01 B	b 4.9 ± 0.02 AB	ab 4.98 ± 0.02 B	a 5.15 ± 0.02 A
	6	c 4.85 ± 0.02 A	ab 5.15 ± 0.02 A	b 5.08 ± 0.01 A	a 5.26 ± 0.01 A

a-c Means within a raw with the same superscript are significantly different ($p<0.05$).

A-E Means within a column with the same superscript are significantly different ($p<0.05$).

Table 7. Juiciness scores in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at −20°C for 6 months.

Parameter		Juiciness			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 6.5 ± 0.09 BC	b 6.0 ± 0.08 E	c 5.8 ± 0.09 F	d 5.0 ± 0.07 C
	1	a 7.1 ± 0.1 B	b 6.2 ± 0.09 E	b 6.3 ± 0.08 E	c 5.2 ± 0.09 BC
	2	a 7.7 ± 0.07 AB	b 6.8 ± 0.1 D	b 6.7 ± 0.1 D	c 5.9 ± 0.09 B
	3	a 8.8 ± 0.07 A	b 8.0 ± 0.08 A	b 7.8 ± 0.01 A	c 7.0 ± 0.1 A
	4	a 8.5 ± 0.1 A	b 7.6 ± 0.1 B	b 7.4 ± 0.06 B	bc 7.0 ± 0.07 A
	5	a 8.5 ± 0.09 A	b 7.5 ± 0.06 B	b 7.4 ± 0.1 B	bc 7.0 ± 0.1 A
	6	a 8.0 ± 0.1 A	b 7.2 ± 0.07 C	b 7.0 ± 0.07 C	c 6.8 ± 0.06 AB

a-d Means within a raw with the same superscript are significantly different ($p<0.05$).

A-F Means within a column with the same superscript are significantly different ($p<0.05$).

Table 8. Appearance scores in common carp fillets and minced blocks, packaged in ice-glaze film or polyethylene bags during storage at -20°C for 6 months.

Parameter		Appearance			
Flesh form		Fillets		Minced	
Packaging		Ice-glaze	Polyethylene	Ice-glaze	Polyethylene
Storage period (Months)	0	a 6.7 ± 0.1 E	b 6.0 ± 0.09 E	b 6.0 ± 0.1 E	c 5.5 ± 0.08 C
	1	a 7.0 ± 0.09 D	c 6.2 ± 0.1 E	b 6.5 ± 0.07 D	d 5.8 ± 0.1 C
	2	a 7.5 ± 0.08 C	b 6.8 ± 0.1 D	b 7.0 ± 0.09 C	c 6.3 ± 0.09 B
	3	a 8.5 ± 0.1 A	b 8.0 ± 0.1 A	b 8.0 ± 0.1 A	c 7.3 ± 0.1 A
	4	a 8.0 ± 0.07 B	b 7.5 ± 0.09 B	b 7.5 ± 0.06 B	c 6.9 ± 0.1 A
	5	a 8.0 ± 0.1 B	b 7.5 ± 0.07 B	b 0.07 ± 0.1 B	c 7.0 ± 0.06 A
	6	a 7.5 ± 0.06 C	b 7.0 ± 0.09 C	b 7.0 ± 0.08 C	c 6.5 ± 0.01 B

a-d Means within a raw with the same superscript are significantly different ($p<0.05$).

A-E Means within a column with the same superscript are significantly different ($p<0.05$).

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التغيرات في الجودة الكيميائية، الميكروبيولوجية والحسية خلال التخزين بالتجميد لبلوكات من المبروك العادي

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تمت هذه الدراسة لمقارنة جودة وثبات شرائح ومفروم سمك المبروك المجهز على هيئة بلوكات (٣ 10x20xسم) والمغلفة إما بالتزجيج (طبقة رقيقة من الماء المثلج) أو بأغلفة البولياثيلين خلال ستة أشهر من التخزين بالتجميد (-٢٠م×).

أظهرت نتائج هذه الدراسة، أن خواص الطزاجة ألكيميائيه (حمض الثيوباربتيوريك، رقم البيروكسيد، القواعد النيتروجينية الكلية الطيارة والأمين ثلاثى الميثيل) والبكتريولوجية (العدد الكلى للبكتريا والبكتريا المحبة للبرودة) قد أوضحت ارتفاعا بطيئا في جميع المعاملات خلال فترة التخزين التجميد، بينما كانت بلوكات شرائح المبروك أكثر ثباتا من تلك البلوكات المجهزة من مفروم المبروك، خاصة بلوكات الشرائح المغلفة بطريقة التزجيج مقارنة بتلك المغلفة بأغلفة البولياثيلين. وكانت هذه النتائج مطابقة للانخفاض بدرجات قليلة في التقييم الحسي (العصيرية والمظهر العام) لجميع العينات، حيث لوحظ أن بلوكات شرائح المبروك كانت الأكثر قبولا من حيث الخواص الحسية مقارنة ببلوكات مفروم المبروك، خاصة بلوكات الشرائح المغلفة بطريقة التزجيج مقارنة بباقي المعاملات.