THE EFFECT OF UTILIZATION CARBOXYMETHYL CELLULOSE PRODUCED FROM RICE STRAW AND BAGASSE CELLULOSE ON THE QUALITY OF SOME PROCESSED FOOD PRODUCTS.

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ABSTRACT

The present study was conducted to explore the possibility of utilization of rice straw and sugarcane bagasse for production one of the largest water soluble cellulose, namely carboxymethyl cellulose (CMC) to be used in improving the Organoleptic properties of some food products. CMC from the two materials (rice straw and bagasse) was used as coating formulation to reduce oil absorption in deep fat fried potato strips, eggplant chips and fish fillet to 25.09%, 31.00% and 17.15% respectively. Also, the appearance, color, texture, odor, taste and overall acceptability of these products were improved by using CMC at 0.5 % concentration for the three fried products. Substitution (0.1 %) of pectin used in manufacture jam by CMC led to improving the properties such as appearance, color, texture, odor, taste and overall acceptability of apricot jam.

Keywords: oil absorption, CMC, apricot jam, bagasse and rice straw.

INTRODUCTION

Carboxymethyl cellulose (CMC) is the most important water soluble cellulose derivative, it used in many applications in the food industry and in cosmetics, pharmaceuticals, detergents and other industries. *(Olaru et al., 1998).*

Sodium carboxymethyl cellulose (Na CMC) is a polyelectrolyte which is formed when chloroacetic acid, or its sodium salt, reacts with alkali cellulose. Na CMC is a copolymer of two units: β-D-glucose and β-Dglucopyranose 2-O-(carboxymethyl)-monosodium salt, not randomly distributed along the macromolecule, which are linked via β-1,4-glycosidic bonds *(Charpentier et al., 1997).*

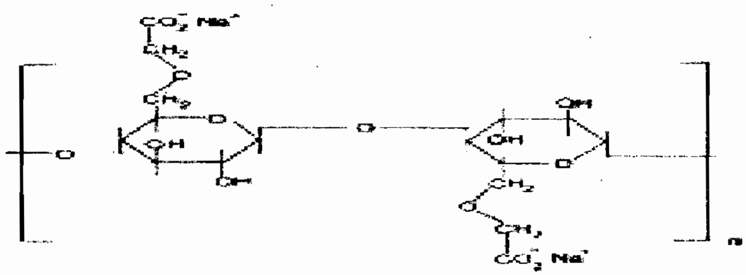

Fig.1. Structure of CMC *Biswal and Singh (2004)*

The various properties of CMC depend upon three factors: molecular weight of the polymer, average number of carboxyl content per anhydroglucose unit and the distribution of carboxyl substituents along the polymer chains *(Reuben and Conner, 1983; Kamide et al., 1985; Baar and Kulicke, 1994)*. Purified CMC is a white- to cream-colored, tasteless, odorless and free-flowing powder *(Keller, 1986)*.

Commercial CMC samples have a degree of substitution (DS) in the range of 0.4 to 1.4 and a degree of polymerization (DP) ranging from 20 to 100 *(Silva et al., 2004)*.

Production of CMC is carried out by conversion of alkali cellulose swollen in aqueous NaOH and a surplus of an organic solvent with monochloroacetic acid or its sodium salt *(Heinze and Pfeiffer, 1999)*.

Frying is one of the oldest cooking methods. This complex operation represents a process, which involves several chemical and physical changes including starch gelatinization, protein denaturation, water vaporization and crust formation. This process affects oxidative and hydrolytic degradation and polymerization of the oil together, with heat transfer and mass transfer. This is characterized by the oil movement into the product, as well as the water movement from the product into the oil. However, these products contain a substantial amount of fat, some as much as 45%, while foods, especially those that are naturally low in fat, absorb large amounts of fat during deep fat frying. The degree of oil absorption is significantly affected by various factors such as process conditions (temperature and time), pretreatment of food, physico-chemical characteristics of food, oil origin, chemical composition of oil and other factors *(Saguy and Pinthus, 1995; Funami and Funami, 1999)*.

Overall, three main possible mechanisms have been proposed in various studies to describe the oil absorption phenomena, namely, water replacement. During frying (basically a drying process), oil replaces the water that has been evaporated. When the food is exposed to frying temperatures, water evaporates rapidly, the outer surface becomes dry and a crust forms. Moisture within the fried product is converted to steam, creating a positive pressure gradient. The steam escapes through cracks, defects, open capillaries and channels in the cellular structure and membranes. As the process progresses, oil adheres to the food, entering the large voids, product imperfections and crevices left by the changes in structure due to frying process and water evaporation. As the voids are quite large, there is no inner resistance due to positive water vapor pressure. This mechanism could furnish a possible explanation for the direct relationship observed between water loss and oil uptake *(Rice and Gamble, 1989).*

Recently, many investigations were carried out with the aim of lowering oil uptake during deep fat frying. They were mostly focused on ingredients addition (chemical compounds) that could lower oil abosrption, cooking parameters (time/temperature) and pre-treatment procedures (osmotic pretreatment, blanching and others) *(Koelsch, 1994; Krochta and De Mulder-Johnston, 1997; Williams and Mittal, 1999).*Hydrocolloids matters have been used as multifunctional additives in food processing. They are added to control and to improve functional properties like viscosity, water binding capacity and emulsion stability. It was also reported that some hydrocolloids matters, mainly long chain polysaccharides, could reduce oil absorption during deep fat frying *(Ang, 1993; Mallikarjunan et al., 1997; Williams and Mittal, 1999).* Some of the most useful hydrocolloids seem to be cellulose derivatives such as methyl cellulose (MC), hydroxypropyl cellulose (HPC) and hydroxypropylmethyl cellulose (HPMC) *(Albert and Mittal, 2002).* All these cellulose derivatives are water-soluble ethers with good film-forming properties and the hydrophility increases in the order HPC<MC<HPMC< CMC.

Hydrocolloids substances are water-soluble, high molecular weight polysaccharides that serve a variety of functions in food systems, such as enhancing viscosity, creating gel-structures, formation of a film, control of crystallization, inhibition of syneresis, improving texture, encapsulation of flavors and lengthening the physical stability, etc. *(Dziezak,1991; Glicksman, 1991; Garti and Reichman, 1993 and Dickinson, 2003).*

Accordingly, this study would cover the following points: Study the effect of treating potato strips, eggplant chips and fish fillet with different levels of CMC (produced from rice straw and bagasse cellulose) on oil absorption and water loss during deep fat frying. Also study the effect of substitution CMC produced from rice straw and bagasse instead of different levels of pectin and on physical properties of apricot jam. Organoleptic qualities of all of these treated products were evaluated.

MATERIALS AND METHODS

Materials:

1- Commercial carboxymethyl cellulose: E.S.C, carboxymethyl cellulose.

2-Carboxymethyl cellulose produced from rice straw and bagasse cellulose by using optimum conditions found by *Elsebaie (2008)* and having a degree of substitution(DS) 0.797 and 0.890 respectively .

The potato tubers(*Solanum tuberosum*) varity Nicola, eggplant(*Solanum melongena*) varity Balady and Fish fillet were purchased from the local market in Kafr El-Sheikh Governorate, Egypt at 2007 season. Sunflower oil was obtained from Tanta company for Oils and Soaps, Tanta city, Egypt.

Methods:

Technological methods:

Potato strips and eggplant chips preparation:

The potato tubers and eggplant were washed, hand-peeled and the potato tubers were cut with a manual operated potato-cutting device into a 8 × 8 × 60 mm strips. While eggplant and fish were cut with a manual cutting device into a 0.8 × 8cm chips and 7 × 5 × 0.5cm fillet, respectively .

Potato strips, eggplant chips and fish fillet coating with CMC:

The strips of potato and the chips of eggplant were blanched in 0.5% aqueous solution of calcium chloride, at 85°C for 6 min After blanching, they were immediately immersed in (0.5 – 1 – 1.5 %) aqueous solution of CMC hydrocolloids at room temperature(25±2°C) for two minutes. The strips were then drained and dried in a convection oven at 150 °C for 3 min to reduce the surface water. Then Potato strips, eggplant chips and fish fillets were immediately immersed in (0.5 – 1 – 1.5 %) aqueous solution of CMC hydrocolloids at room temperature for two minutes. Then, the investigated samples were drained and dried in a convection oven at 150 °C for 3 min to reduce the surface water The Potato strips, eggplant chips and fish fillets were fried at180± 10 °c for 6 min in sunflower oil with a constant product weight /oil volume at ratio of 1:6. Because so much oil is removed along with the fried products, after each frying the oil level was checked and replacement. All fried samples were allowed to cool to room temperature (*Rimac-Brncic et al.*, 2004).

Using CMC in manufacturing apricot jam:

The formula used for manufacturing apricot jam was recommended by *Abu-Foul* (1997). Apricots were washed several times by tap water to remove any foreign matters. Then separated from seeds and cut to small pieces. Sugar was added to the apricot at the level of (1:1 w/w), mixed well, then one of the following thickening agent : 0.1% pectin, 0.3% pectin , 0.5% pectin, 0.1% CMC, 0.3% CMC and 0.5% CMC were added and cooked for 40 minutes with manual stirring. The produced jam was filled in sterilized glass jar and stored at room temperature for sensory evaluation and other tests.

Analytical methods:

Determination of moisture content in CMC:

Moisture content in the CMC produced from rice straw and sugarcane bagasse cellulose and commercial CMC was preformed in an air oven at 105°C until reaching to a constant weight according to the methods described in (A.O.A.C., 2000).

Determination of CMC content:

CMC content was determined according to the method described by *Far (1992)* as follows:

1.5 g of CMC was added to 100 ml of 80% methanol, stirred, kept for 10 min and

filtered. Cake was washed by 100 ml of 80% methanol and dried.

CMC content% = $(100 \times M_2) \div M_1$

Where M_1 (g) is the weight of CMC sample and M_2 (g) is the weight of washed dried sample.

Determination of degree of substitution:

The degree of substitution of CMC was determined by the standard method *(ASTM, 1961)*. 108 ml of HNO3 65% was made to one liter by methanol. Five grams of produced and commercial CMC was shaken with 200 ml of diluted HNO3–methanol mixture, kept for 3 h then filtered and the surplus acid was washed with 70% methanol. Two grams of dried washed CMC was added to 200 ml of distilled water and 30 ml of 1N NaOH, After dissolving the mixture was titrated with 1N HCl. The DS of CMC was determined by the following equations reported by *ASTM (1961)* as modified by *Barai et al.(1997)*.

$$DS = 0.162A / (1 - 0.058A) \qquad A = (BC - DE)/F$$

where A is the equivalent weight of alkali required per gram of sample; B, (ml) of NaOH solution; C, the normality of NaOH solution; D, (ml) of HCl solution; E, the normality of HCl solution and F, grams of sample(2gm).

Oil absorption determination:

Oil content was determined by 6 h Soxhlet extraction using petroleum ether(40- 60 °C) as solvent *(Pardun, 1969)*.

Water loss during frying determination:

Water loss during frying was calculated from the following equation as outlined by *Albert and Mittal. (2002)*:

Water loss percentage during frying = [(initial water content – water content after frying) / initial water content] × 100

Viscosity determination:

Viscosity determination was conducted in the central laboratory of Alexandria Univ., by using rotational viskosimeter RHEO TEST type RV according to the methods described in the *A.O.A. C. (2000)*.

Sensory evaluation of prepared foods:

Jam and potato containing CMC were sensory tested for their color, appearance, odor, texture, taste and overall acceptability on a 1 to 10 hedonic scale as described by *El-Sheikh. (1999)*. A panel consisting of 20 judges was formed from the personal of the university laboratories.

▼ Score sheet: Dislike extremely =1; dislike very much = 2; dislike moderately = 3; dislike slightly = 4; neither like nor dislike = 5; like slightly = 6; like moderately = 7; like very much = 8 and like extremely = 9

Statistical analysis:

The data were analyzed according to *Steel and Torrie (1980)*. A one way analysis of analysis of variance (ANOVA) using the general linear models (GLM) procedure was used to test for main effects where more than two variables being compared. Differences with P values ≤ 0.05 were considered to be statistically significant.

RESULTS AND DISCUSSIONS

Characteristics of the CMC produced from rice straw and bagasse cellulose in comparison with commercial CMC :

Results given in Table (1) showed that the CMC produced from bagasse, which had a high DS (0.890) and a high CMC % (74.59) followed by the CMC produced from rice straw, which had (0.797) DS and (71.84) CMC % while the commercial CMC, had (0.763) DS and (59.82) CMC %. Besides, one can observe that CMC produced from either bagasse cellulose or from rice straw cellulose and Commercial CMC all were odorless, tasteless and flowing powder qualities.

Table (1) characteristics of the CMC produced from rice straw and bagasse cellulose and commercial CMC:

Parameters	CMC produced from		Commercial CMC
	Rice straw cellulose	bagasse cellulose	
Degree of substitution	0.797	0.890	0.763
CMC %	71.84	74.59	59.82
Moisture	4.51	4.93	6.47
Color	white	white	white
Odor	odorless	odorless	odorless
Taste	tasteless	tasteless	tasteless
Appearance	**Free flowing powder**	**Free flowing powder**	**Free flowing powder**

Data in the same Table reported that the commercial CMC had a high moisture content (6.47%) followed by CMC produced from bagasse, which had moisture content (4.93%), Then the CMC produced from rice straw, which had moisture content (4.51%) these findings were support of results obtained by *Adinugraha et al. (2005)* who found similar results. Also, one can observe that the color of CMC produced from rice straw cellulose or from rice straw cellulose and commercial CMC were white in all samples. Data given in Table (1) are in completely agreement with that obtained by *keller (1986)*.

Effect of the concentration of CMC used in coating on oil absorption in potato strips, eggplant chips and fish fillet during frying:

Data in Table (2) showed that dipping potato strips in 1.5 % CMC decreased the oil absorption in potato strips decreased from 31.54% (in the untreated sample) to 26.00 % and 25.09 % by using 1.5 % CMC produced from rice straw and bagasse, respectively. Using CMC from either rice straw cellulose or bagasse cellulose caused a decrease in the oil absorption and this decrement increases gradually with increasing CMC concentration. While, in case of eggplant chips it could be observe that the increasing of CMC concentration from 0.5 % to 1.5 % the oil absorption was decreased from 38.12% (in the untreated sample) to 32.6 % and 31.00 % when using 1.5 % CMC produced from rice straw and bagasse, respectively. On the other hand, the increase of CMC concentration from 0.5 % to 1.5 % the oil absorption in fish fillet was decreased from 23.5% (in the untreated sample) to 18.03 % and 17.15 % when using 1.5 % CMC produced from rice straw and bagasse, respectively. Therefore, it could be recommended that before frying potato strips must be dip in 1.5% CMC hydrocolloid solution to reduce oil absorption. It is known that hydrocolloid treatment may alter the water holding capacity and consequently affect oil absorption *(Pinthus et al., 1992)*.

Table (2): Effect of various coating concentration of carboxymethyl cellulose produced from rice straw and bagasse cellulose on oil absorbation and water loss during frying of some fried products.

Treatments of CMC	CMC Concen-tration	Oil absorbation%			Water loss during frying %		
		Potato strips	Eggplant chips	Fish fillet	Potato strips	Eggplant chips	Fish fillet
Untreated	Untreated	31.54^{a}	38.12^{a}	23.5^{a}	16.48^{a}	11.68^{a}	22.92^{a}
CMC produced from rice straw	0.5	29.17^{ab}	35.92^{b}	20.95^{b}	14.30^{b}	10.45^{b}	19.12^{b}
	1.00	27.94^{bc}	33.43^{c}	19.74^{bc}	13.64^{c}	8.69^{c}	17.32^{c}
	1.5	26.00^{c}	32.6^{d}	18.03^{de}	10.33^{d}	6.56^{f}	16.41^{d}
CMC produced from Bagasse	0.5	28.2^{b}	34.03^{c}	20.2^{bc}	14.53^{b}	9.85^{d}	17.95^{c}
	1.00	27.35^{c}	32.3^{d}	19.1^{cd}	9.57^{e}	7.80^{e}	16.64^{d}
	1.5	25.09^{d}	31.00^{e}	17.15^{e}	8.80^{f}	6.14^{f}	16.19^{d}

Effect of the concentration of CMC in coating on water loss during frying of potato strips, eggplant chips and fish fillet:

The results in Table (2) showed that there is a significant difference in water loss during frying process between untreated and treated samples. The results indicated that, with increasing the coat concentration of CMC produced from rice straw from 0.0 % to 1.5 % the water loss decreased from 16.48% to 10.33% in potato strips. The water loss also decreased from11.68% to 6.56% and from 22.92% to16.41% in eggplant chips and fish fillet, respectively. On the other hand, one can observe that with increasing the coat concentration of CMC produced from bagasse from 0.0 % to 1.5 % the water loss decreased from 16.48% to 8.80%, from 11.68% to 6.14% and from 22.92% to16.19% in potato strips, eggplant chips and fish fillet, respectively. The ability of CMC derivatives at 1.5% for reducing oil uptake could be apart others due to the increase of water holding capacity by entrapping moisture and consequently due to prevention of moisture replacement by oil *(Garcia et al., 2002)*.

Data in Table (2) showed that CMC produced from bagasse was more effective in reducing oil absorption than the one which produced from rice straw. Such effect was related to its property (high in DS and solubility).

Organoleptic evaluation of fried potato strips:

In all food sorts, organoleptic evaluation is considered one of the most important parameter that can be taken as a final guide to determine their quality from the consumer point of view. The influence of treatments with different concentrations of CMC produced from rice straw and bagasse cellulose on the organoleptic properties of the fried potato strips was studied. The received data were statistically analyzed and illustrated in Table (3). The obtained results indicated that the potato strips treated with 0.5 % of CMC produced from bagasse cellulose had the highest value for appearance, color, odor, taste and overall acceptability comparison with those prepared by other concentrations and the control sample. On the other hand, the potato strips treated with 0.5 % of CMC produced from rice straw cellulose had the highest value for texture. Similar results were obtained by *Garcia et al. (2002)* who reported that MC coatings improved the sensory attributes of fried potato strips. Actually, the differences in the scores were statistically significant at $p \leq 0.01$.

Table (3): Organoleptic properties of fried potato strips coated with different concentrations of CMC produced from rice straw and bagasse cellulose.

Type of treatment	CMC Concentration %	Properties of fried potato strips					
		Appea -rance	texture	color	odor	taste	Overall acceptability
Control	0.0	7.6[c]	7.74[b]	7.8[b]	7.86[b]	7.66[b]	7.74[b]
CMC 1	0.5	7.92[b]	8.00[a]	8.20[a]	8.14[a]	7.80[a]	8.02[a]
	1.00	7.46[d]	7.20[c]	7.40[c]	7.66[c]	7.14[c]	7.78[c]
	1.5	7.50[c]	6.60[d]	6.20[d]	7.24[b]	7.40[bc]	6.98[d]
CMC 2	0.5	8.26[a]	7.66[b]	8.40[a]	8.34[a]	6.74[d]	8.08[a]
	1.0	7.06[e]	6.94[bd]	7.46[c]	7.66[c]	6.94[d]	7.22[c]
	1.5	7.00[e]	6.00[e]	6.08[d]	6.42[d]	6.26[e]	6.36[d]

CMC1: produced from rice straw cellulose CMC2: produced from bagasse cellulose

Values followed by the same letter in column are not significantly different at $p \leq 0.01$.

Organoleptic evaluation of fried eggplant chips:

Data in Table (4) showed the organoleptic scores of eggplant chips treated with different coat concentrations. From the tabulated results given in Table (4), it is clear that eggplant chips treated with (0.5 %) CMC produced from bagasse cellulose or those treated with (0.5 %) CMC produced from rice straw cellulose had relatively the best appearance, texture, color, odor, taste and overall acceptability when compared with the other manufactured eggplant chips or untreated samples (control). With regard to the attained results, it could be concluded that, all tested products had scores more than 5, indicating that all samples were organoleptically accepted for odor, appearance, texture, Color and test as well as the overall acceptability. The mean values of the overall acceptability of CMC treated samples were lower than those of the control. This my be due partly to the fact that the CMC treated samples are considered a new product and the Egyptian consumer is not familiar to it. These results are in agreement with other data reported by *Salvador et al. (2008)* who mentioned that methyl cellulose coatings improved Consumer acceptability of fried products.

Table (4): Organoleptic properties of eggplant chips coated with different concentrations of CMC produced from rice straw and bagasse cellulose.

Type of treatment	CMC Concentration %	Properties of fried egg plant chips					
		Appearance	texture	color	odor	taste	Overall acceptability
Control	0.0	9.00[a]	7.3[a]	8.8[a]	8.5[a]	7.66[ab]	8.25[a]
CMC 1	0.5	6.40[c]	7.00[ab]	7.80[bc]	8.20[ab]	8.60[a]	7.60[b]
	1.0	7.60[b]	7.40[a]	8.00[b]	7.60[b]	8.10[a]	7.74[b]
	1.5	7.00[b]	6.80[b]	8.00[b]	8.00[b]	8.00[a]	7.56[b]
CMC 2	0.5	8.20[a]	7.60[a]	7.80[bc]	8.80[a]	7.60[ab]	8.00[a]
	1.0	6.20[c]	6.80[b]	6.20[d]	7.00[c]	7.80[ab]	6.8[c]
	1.5	5.20[d]	6.20[c]	6.00[d]	6.00[d]	7.00[c]	6.08[d]

CMC1: produced from rice straw cellulose CMC2: produced from bagasse cellulose

Organoleptic evaluation of fried fish fillet:

Data given in Table (5) indicated that the best organoleptic properties were obtained when CMC produced from rice straw and bagasse cellulose was used at 1.00% and 0.5 %, respectively comparing with control. From obtained results, it could be concluded that, all these products had scores more than 5, showing that all samples were organoleptically accepted for appearance, texture, color, odor, taste and overall acceptability. The mean values of the overall acceptability of CMC treated samples were lower than that of the control. This my be due partly to the fact that CMC treated samples are considered a new product and the Egyptian consumer is not familiar to it comparing with un treated product. Similar results were obtained by *Mallikarjunan et al. (1997)* who reported that HPMC coatings improved the sensory attributes of fried chicken and marinated chicken stripes. There was a high significant differences between untreated sample and the other samples at $P \leq 0.01$.

Table (5): Organoleptic properties of fried fish fillet coated with different concentrations of CMC produced from rice straw and bagasse.

Type of treatment	CMC Concentration %	Properties of fried fish fillet					
		Appearance	texture	color	odor	taste	Overall acceptability
Control	0.0	8.7^{a}	8.4^{a}	8.3^{a}	9.5^{a}	8.00^{ab}	8.58^{a}
CMC 1	0.5	7.6^{d}	7.8^{c}	7.55^{b}	8.95^{bc}	7.9^{ab}	7.96^{d}
	1.00	8.55^{a}	7.9^{bc}	8.3^{a}	8.95^{bc}	7.6^{b}	8.26^{bc}
	1.5	6.85^{e}	7.2^{d}	7.2^{c}	8.7^{cd}	8.1^{a}	7.61^{e}
CMC 2	0.5	8.25^{b}	8.15^{ab}	8.05^{a}	9.2^{ab}	7.8^{ab}	8.29^{b}
	1.00	7.85^{c}	7.85^{bc}	8.35^{a}	8.9^{bcd}	8.1^{a}	8.21^{c}
	1.5	6.95^{e}	7.3^{d}	7.7^{b}	8.6^{d}	7.8^{ab}	7.67^{e}

CMC1: produced from rice straw cellulose CMC2: produced from bagasse cellulose

Effect of the substitution of pectin with CMC produced from rice straw and bagasse cellulose on physical properties of apricot jam:

Data given in Table (6) show that the viscosity and pH for apricot jam supplemented with different levels of CMC produced from rice straw and bagasse cellulose comparing with pectin (0.1, 0.3 and 0.5 %). It should be noted from the given data that, with the increasing of CMC produced from rice straw and bagasse cellulose or pectin concentration from 0.1 to 0.5 the viscosity of apricot jam increased to 2010 centpoise , 2700 centpoise and 1890 centpoise, respectively. Results in the same table show that, no significant differences were observed between the average values of pH, while there were significant differences between the values in viscosity. From the results in Table (6), it is apparent that using CMC gave viscosity higher than the same level of pectin . This may be due to CMC high water binding capacity *(Garti et al., 1993)*. On the other hand, using CMC produced from bagasse cellulose gave viscosity higher than using the same level from CMC produced from rice straw. This may be due to its high degree of substation. From the results in Table (6) it should be also concluded that, gaining the same level of viscosity which occurred by pectin needed a smaller quantity of CMC so that we can depend on CMC in the production of jam with high quality at little costs. These results are in agreement with those of obtained by *Satota (1978)*.

Table (6): Effect of various concentration of pectin and CMC obtained from rice straw and bagasse on some physical properties of apricot jam:

Type of treatment	Concentration %	Viscosity (cent poise)	pH
Pectin	0.1	1323^{i}	3.3^{a}
	0.3	1538^{h}	3.5^{a}
	0.5	1890^{e}	3.5^{a}
CMC produced from rice straw	0.1	1620^{g}	3.4^{a}
	0.3	1995^{d}	3.3^{a}
	0.5	2010^{b}	3.3^{a}
CMC produced from Bagasse	0.1	1755^{f}	3.5^{a}
	0.3	2000^{c}	3.4^{a}
	0.5	2700^{a}	3.4^{a}

Organoleptic evaluation of apricot jam:

Results in Table (7) show the organoleptic score of apricot jam. Results tabulated in Table (7) indicated that jam treated with (0.1 %) CMC produced from rice straw cellulose and jam treated with (0.1 %) CMC produced from bagasse cellulose have relatively the best appearance, texture, color, odor, taste and overall acceptability when compared with the other manufactured jams. Regarding to the attained results, it could be concluded that, all these products had scores more than 5, showing that all samples were organoleptically accepted with regard to appearance, texture, color, odor, taste and overall acceptability. Furthermore, no significant differences were recorded among the average of texture and odor of all treated sample at $P \leq 0.01$. On the other hand, significant difference in Color, appearance, taste and overall acceptability between apricot jam prepared with CMC produced from rice straw cellulose, CMC produced from bagasse cellulose and pectin.

Table (7): Organoleptic properties of apricot jam manufactured by using different concentrations of pectin and CMC produced from rice straw and bagasse cellulose.

Type of treatment	CMC Concentration %	Properties of apricot jam					
		Appearance	texture	color	odor	taste	Overall acceptability
pectin	0.1	6.2[bc]	6.6[a]	6.4[ab]	6.8[a]	7.2[bc]	6.64[bc]
	0.3	7.4[abc]	7.6[a]	7.4[ab]	7.8[a]	8.0[a]	7.64[ab]
	0.5	7.6[abc]	7.0[a]	7.4[ab]	8.2[a]	8.0[a]	7.64[ab]
CMC 1	0.1	7.6[abc]	7.8[a]	8.0[ab]	8.2[a]	7.8[a]	7.88[a]
	0.3	5.4[c]	6.2[a]	6.0[b]	6.2[a]	6.6[d]	6.08[c]
	0.5	8.00[ab]	7.4[a]	7.6[ab]	7.6[a]	7.4[ab]	7.6[ab]
CMC 2	0.1	8.6[a]	7.6[a]	8.2[a]	8.2[a]	7.6[ab]	8.04[a]
	0.3	6.6[abc]	7.8[a]	6.8[ab]	7.2[a]	7.2[ab]	6.92[abc]
	0.5	7.0[abc]	7.0[a]	6.6[ab]	7.2[a]	6.8[bc]	6.92[abc]

CMC1: CMC produced from rice straw cellulose CMC2: CMC produced from bagasse cellulose

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الملخص العربي

تأثير إستخدام الكربوكسي ميثايل سليلوز المنتج من كلا من قش الأرز ومصاصة القصب علي جودة بعض الأغذيه المصنعة.

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أجريت هذه الدراسة بهدف بحث إمكانية أستخدام واحد من أكثر مشتقات السليلوز ذوبان في الماء وهو الكربوكسي ميثايل سليلوز في تحسين الخواص العضوية الحسية لبعض الأغذية . و قد أوضحت نتائج الدراسة أن تغطية بعض المنتجات الغذائية بواسطة الكربوكسي ميثايل سليلوز المنتج من قش الأرز ومصاصة القصب قد استخدمت لخفض نسبة الزيت الممتص خلال عملية القلي إلي ٢٥,٠٩ ، ٣١,٠٠ و١٧,١٥% في كلا من أصابع البطاطس و شرائح الباذنجان وفيليه السمك علي الترتيب.

كما أوضحت النتائج أن استخدام نوعي الكربوكسي ميثايل سليلوز بتركيز ٠,٥ % قد أدي إلي تحسين المظهر ، اللون، القوام ، الرائحة، الطعم و القبول العام للمنتجات المدروسة.

كما أوضحت النتائج أن استخدام نوعي الكربوكسي ميثايل سليلوز بتركيز ٠,١ % أدي إلي تحسين المظهر ، اللون، القوام ، الرائحة، الطعم و القبول العام في مربي المشمش.