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PREFERENCE EVALUATION OF PROCESSED CHEESE SAUCE WITH DIFFERENT THICKENING AGENTS

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ABSTRACT

A highly stable rich creamy cheese sauce containing different starch additives were manufactured. Ripened Ras cheese and skim milk powder with different thickening agents: Corn starch (CS), Modified corn starch (MCS), Unmodified wheat starch (UMW) and Rice flour (RF) were used to formulate the blends. All formulations even the control was adjusted to contain 25 % total solids (TS) and 40 % fat / dry matter (F/DM). All samples were chemically analyzed for: TS, F / DM, total nitrogen (TN), soluble nitrogen (SN), pH, salt / moisture, ash and TVFA. Treatments of thickening agents showed slightly lower TN content than the control which had higher ash and salt / moisture content compared to the other treatments. Control cheese sauce had the lowest pH value compared to the other treatments. Use of starches improved and stabilized well the body & texture and enhanced the viscosity of produced sauces. Sensory quality attributes were also evaluated. All treated samples showed higher scores than the control. The pH values decreased while SN content and TVFA values increased with extending the storage period especially at room temperature. Cheese sauces were shelf stable and had good flavour & mouth feel.

Key words: Cheese sauce, processed Ras cheese, starch, rice flour.

INTRODUCTION

Cheese sauce is a novel cheese product nowadays, not only for it's attractive appetizer but also being perceived as a first course or a side dish and rather as an ingredient entire, meant to stand by itself. Cheese sauce can be used for wide range of dishes like macaroni and

other pasta dishes and can create line – extension opportunities for breaded and battered products, such as chicken breasts, nuggets and fingers, in addition can be added to meat or barbecue dishes. In the development of new soups and sauces, cheese may play an increasingly important role for a number of reasons: cheese which provides a solid base in which a number of ingredients can be incorporated and can create texture and viscosity, act as a flavour carrier while releasing other flavors, contribute dairy notes, and enhance visual appeal, (Pszczola, 2001). Most of cheese sauce varieties in the market including cheese as cheese powder or just cheese flavour. Blends of natural cheeses can attribute special natural flavours and texture in dipping sauces, toppings, and other applications. The cheese sauce exhibits a desirable texture and mouth feel, as well as a desirable flavour and visual appearance. Further, the cheese sauce generally includes cheese solids present in an amount from approx. ≤10 wt. %, ≥1 non-cheese dairy product, water, a natural preservative such as nisin, ≥1 phosphate, salt, oil and a savoury flavour profile. The cheese sauce can be processed using a pasteurization process and packaged using a hot fill process. (Gamay *et al,* 2009). The functionality and nutritive value of dairy based ingredients can help to enhance the value of soups and sauces, as well as stimulate the development of future products. By controlling the concentration of ingredients in the fluid, the intensity of the flavour in the final product is adjusted, making possible a wide variety of consumer made specialty cheeses. The use of starches in sauces can provide greater stability for the food formulator. Starch suits for mild to moderate processing conditions, provides rapid, high viscosity development and imparts excellent cold temperature storage stability. Sauces made with starches usually exhibit smooth and creamy mouth feel, shelf stable and high quality, (Pszczola, 2000).

Cheese sauce is not well established in Egyptian market even it can be a very good and cheap appetizer. Most of cited literatures were found in patents and hence, to our knowledge no enough information has been published regarding the manufacture and production of different types of cheese sauce. We are looking for offering delicious and favourable cheese sauce formulas with highly acceptable quality to be suitable for Egyptian consumer. Therefore the current study was planned to investigate processed cheese sauce formulations using Ras cheese and skim milk powder with different thickening materials.

MATERIALS AND METHODS

Materials:

Ripened Ras cheese was purchased from the local market, Cairo, Egypt. Skim milk powder used in the present study was obtained from Dina farm, Egypt. Corn starch (CS) and Modified corn starch (MCS) were obtained from the Starch and Glucose Company, Cairo, Egypt and Misr Food Additives MIFAD, Giza, Egypt, respectively. Unmodified wheat starch S5127 (UMW) was obtained from Sigma Chemical Co., USA, whereas rice flour RF-W1120 F8141 (RF) was obtained from Comet Rice Ingredients Co., USA. Butter oil brand name NZ imported from New Zealand Dairy Board, Wellington, New Zealand, was obtained from the local market. Commercial fine grade sodium chloride was obtained from EL-Nasr Salines Co., Alexandria, Egypt. Nisin produced by Zhejiang Silver Elephant Bio – Engineering Co., China, was obtained from Amson International Trading, Giza – Egypt, and used as a preservative. Commercial emulsifying salt S_9 special was obtained from JOHA BK Ladenburg corp., GmbH, Ladenburg, Germany. The chemical composition of ingredients used in manufacture of processed cheese sauces are presented in Table (1).

Table (1): Chemical composition (percent) of ingredients used in manufacture of processed cheese sauces.

Ingredients	Total solids	F/DM	Salt/ moisture	Total nitrogen	Ash
Ras cheese	68.88	47.35	8.93	4.87	4.13
CS	87.00	0.57	ND	0.05	0.40
MCS	88.00	0.50	ND	0.04	0.40
UMW	90.6	0.51	ND	0.03	0.38
RF	88.25	1.21	ND	1.25	0.62
Skim milk powder	96.90	1.14	ND	5.51	7.84

ND: Not determined

CS : Corn starch, **MCS :** Modified corn starch, **UMW :** Unmodified wheat starch, **RF :** Rice flour

Processed cheese sauce Manufacture:

Ras cheese blocks were cut into small portions suitable to be fed through the inlet of a shredding machine (Braun mincer, Germany). Shredded cheese was milled in milling machine, (National, Japan). Suitable amount of Ras cheese, skim milk powder, butter, NaCl, nisin, starch and emulsifying salt were added consecutively in a laboratory style–processing Kettle locally made in Egypt. Specifications of the cooking machine were previously mentioned by Awad (1996). The ingredients were mixed for about 1 min before processing. Control treatment was adjusted to have the same composition without adding starch or rice flour. The mixture was cooked for 10 min at 85 – 90 °C using indirect steam at pressure of 1.5 – 2.0 Kg/cm^2. The melted processed cheese sauce was purred into wide mouth glass jars (150 g) and capped directly after filling. The resultant cheese sauce was cooled at room temperature and then analyzed when fresh and monthly up to 3 months during storage either at refrigerator (5°C ± 2) or room temperature (25°C ± 2). Formulations composition of different processed cheese sauces are shown in Table (2).

Table (2): Formulations of different processed cheese sauces blends (kg/ 100kg).

Ingredients	Treatments*				
	Control	CS	MCS	UMW	RF
Ras cheese	21.24	15.99	15.99	15.99	15.99
Fat	0.75	3.00	3.00	3.00	3.00
Thickening agent	-	3.00	3.00	3.00	3.00
Skim milk powder	1.50	1.50	1.50	1.50	1.50
Emulsifying salt	1.50	1.50	1.50	1.50	1.50
Nisin	0.01	0.01	0.01	0.01	0.01
Water	75.00	75.00	75.00	75.00	75.00
Total	100.00	100.00	100.00	100.00	100.00

* See legend to Table (1) for details

Methods of analyses:

Cheese sauce samples were tested for moisture, titratable acidity and ash as mentioned by AOAC (2005). Fat and salt contents were determined according to the method described by Ling (1963). Total nitrogen (TN) and soluble nitrogen (SN) contents were measured using the semi micro-Kjeldal method as mentioned by AOAC (2005). Total volatile fatty acids (TVFA) value was determined according to the method described by KosiKowski (1982) and values were expressed as ml of 0.1 N NaOH / 100 g cheese sauce. Values of pH were measured using the electric HANNA instrument pH 213 microprocessor pH meters by inserting the pH combined glass electrode (Electric Instruments limited) directly in the sample. Viscosity of processed cheese sauce samples was measured when fresh and after 3 months of storage at either refrigerator (5 ± 2 ºC) or room temperature (25 ± 2 ºC) using a coaxial rotational viscometer Brookfield Engineering labs DV- III ultra rheometer at shear rates ranging from 12.411 to 74.467. The measuring device spindle (HA-07) was used with a sample volume of 110 g per run. Sensory evaluation was carried out according to the Scheme of Meyer (1973). The evaluation was done by regular scoring panel of members in the Food Science Department, Faculty of Agriculture, Ain Shams University and Dairy department, Food Technology Research Institute, Agricultural Research Center. Statistical analysis was performed according to SAS Institute (2006) using General Linear Model (GLM). Duncan's multiple rang was used to separate among means of three replicates of samples.

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of processed cheese sauces with thickening agents are presented in Table (3). The total solids (TS) and F / DM were adjusted in the formula before cooking and therefore the differences were not pronounced among all treatments. These differences could be due to the differences in the formula weight of individual ingredients used in formulating the processed cheese sauce blends. Control product contained higher TN than the other treatments this may be due to addition of different thickening materials decreased the amount of cheese base used to formulate the blends. Treatments of thickening agents showed slightly lower TN content than the control.

These related to the addition of thickening agents which caused differences in cheese base used to adjust the end total solids (TS) content in all treatments. The data also indicated that the control cheese sauce had higher ash content as compared with processed cheese sauce with different additives. This is due to the differences in the amount of cheese base used to formulate the blends. Modified corn starch treatment exhibited the highest salt/moisture content while the treatment with corn starch exhibited the lowest content among the experimental treatments. The control had highest content in salt/moisture than other treatments. These differences could be due to that the amount of Ras cheese base used in formulating the control was much higher than the corresponding quantities in the experimental treatment.

Table (3): Chemical composition (%) of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents.

Treatments*	Total solids	Fat/Dry Matter	Total nitrogen	Ash	Salt/ moisture
Control	25.91	40.85	1.92	3.23	7.98
CS	25.10	41.07	1.30	3.08	6.97
MCS	25.53	40.74	1.23	3.06	7.42
UMW	25.53	40.47	1.26	2.82	7.14
RF	25.12	41.06	1.26	2.93	7.03

* See legend to Table (1) for details

pH value

The data in Table (4) reveal that all treatments of processed cheese sauce with different thickening materials had pH values slightly higher than the control. It is clear that the addition of different varieties of thickening agents decreased the amount of cheese base used to formulate the blends. Cheese base which contain components resulting from maturation of cheese caused decrease in pH values, (Hofi, *et al.,* 1970). During storage of the resultant processed cheese sauces up to 3 months, the pH values tended to decrease gradually and the decrease was significant after 3 months of storage at 25 °C. The

reduction of pH values during storage could be due to hydrolysis of polymerized phosphate present in the emulsifying salts and their interaction with proteins as well as of lactose. The data obtained agree with the finding of Younis *et al*., (1991 a), Aly *et al*., (1995) for processed cheeses.

Table (4): The pH values of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents when fresh and during storage.

Treatments*	Fresh	1 Month		3 Months	
		5°C	25°C	5°C	25°C
Control	5.78 Aa	5.77 Aa	5.75 Aa	5.67 Aab	5.60 Ab
CS	5.87 Aa	5.87 Aa	5.85 Aa	5.76 Aab	5.65 Ab
MCS	5.85 Aa	5.85 Aa	5.82 Aa	5.78 Aab	5.66 Ab
UMW	5.86 Aa	5.85 Aa	5.84 Aa	5.78 Aab	5.67 Ab
RF	5.87 Aa	5.85 Aa	5.84 Aa	5.75 Aab	5.65 Ab

* See legend to Table (1) for details

A, B, C: Means with the same letter among treatments in the same storage period are not significantly different.

a, b, c: Means with the same letter in the treatment during storage period are not significantly different.

Soluble nitrogen (SN)

Soluble nitrogen (SN) content of processed cheese sauce is shown in Table (5). Control treatment had the highest SN content compared to the other treatments made with different additives. There were slight differences in SN content among the other treatments. Soluble nitrogen content was the highest in processed cheese sauce made with modified corn starch and the lowest content was in that made with wheat starch. The results illustrate that SN content was affected by adding the different starch varieties and rice flour in the blends. Adding the prementioned material decreased the amount of cheese added which contribute in the SN content in the blends. On the other hand, soluble nitrogen content increased during storage in all treatments even the control, being higher in sauces stored at room

temperature. The changes in SN content during storage could be a result of enzymatic activity of resistant heat proteinases present in the product. It could also be due to the hydrolysis of polyphosphates in emulsifying salt added during processing as they increase the solubility of proteins especially at room temperature. Meanwhile these results agree with those reported by Abd EL-Hamid *et al.*, (2000), Awad (2003), Awad and Salama (2010) for processed cheeses.

Table (5): Soluble nitrogen content (%) of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents when fresh and during storage.

Treatments*	Fresh	1 Month		3 Months	
		5°C	25°C	5°C	25°C
Control	1.089^{Ab}	1.103^{Ab}	1.211^{Aab}	1.267^{Aa}	1.337^{Aa}
CS	0.941^{Bc}	1.046^{Abc}	1.070^{Abc}	1.166^{Aab}	1.236^{Ab}
MCS	1.089^{Ab}	1.108^{Ab}	1.118^{Ab}	1.149^{Aab}	1.279^{Aa}
UMW	0.931^{Bc}	1.077^{Ab}	1.106^{Ab}	1.185^{Aab}	1.284^{Aa}
RF	0.976^{ABa}	1.008^{Ac}	1.059^{Abc}	1.178^{Aab}	1.237^{Aa}

* See legend to Table (1) for details

A, B, C: Means with the same letter among treatments in the same storage period are not significantly different.

a, b, c: Means with the same letter in the treatment during storage period are not significantly different.

Total volatile fatty acids (TVFA)

Total volatile fatty acids (ml 0.1N NaOH/100 g cheese sauce) in processed cheese sauce with thickening agents are shown in Table (6). These data show that processed cheese sauce with corn starch and rice flour had the highest values of TVFA compared with the other treatments. While processed cheese sauce with wheat starch was the lowest among all treatments. These differences may be correlated to the fat content of each treatment which affects the TVFA values, also the differences in amount of raw materials used to formulate the blends. Control cheese sauce had a moderate value of TVFA among

the treatments. All treatments exhibited higher TVFA values during storage especially after 3 months at room temperature. This may be due to the residual activity of heat–resistant lipases presented in the blend and caused the fat hydrolysis. These results agree with those given by EL-Neshawy *et al.,* (1987), Aly *et al.,* (1995), and Othman *et al* (2005).

Table (6): Total volatile fatty acids values (TVFA)* of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents when fresh and during storage.

Treatments*	Fresh	1 Month		3 Months	
		5°C	25°C	5°C	25°C
Control	16.5^{Ce}	17.8^{Bd}	18.6^{De}	23.7^{Eb}	30.6^{Ea}
CS	17.1^{Be}	19.0^{Ad}	21.1^{Ac}	25.3^{Db}	34.3^{Da}
MCS	16.2^{De}	17.3^{Cd}	21.0^{ABc}	28.6^{Cb}	51.2^{Aa}
UMW	15.4^{Ee}	17.0^{Dd}	20.9^{Bc}	30.4^{Bb}	49.0^{Ca}
RF	17.8^{Ae}	19.0^{Ad}	20.6^{Ce}	31.2^{Ab}	50.2^{Ba}

* See legend to Table (1) for details

TVFA* : ml NaOH 0.1 N / 100 g cheese

A, B, C: Means with the same letter among treatments in the same storage period are not significantly different.

a, b, c: Means with the same letter in the treatment during storage period are not significantly different.

Viscosity

Changes in viscosity values (cp.) of processed cheese sauces as affected by the addition of different thickening materials are given in Fig. (1). The data revealed that the viscosity decreased with increasing the shear rate. The treatments showed different flow behaviour with various additions of different thickening agents in the blends. The control treatment made without addition of any thickening agent had the lower viscosity values. Use of starch materials improved and stabilized well the body & texture. From the data it is clear that corn starch sauce had the highest viscosity values, meanwhile rice flour sauce had the lowest viscosity compared with the other sauces. The differences in viscosity values could be related to the difference among thickening agents in the capacity of binding water which

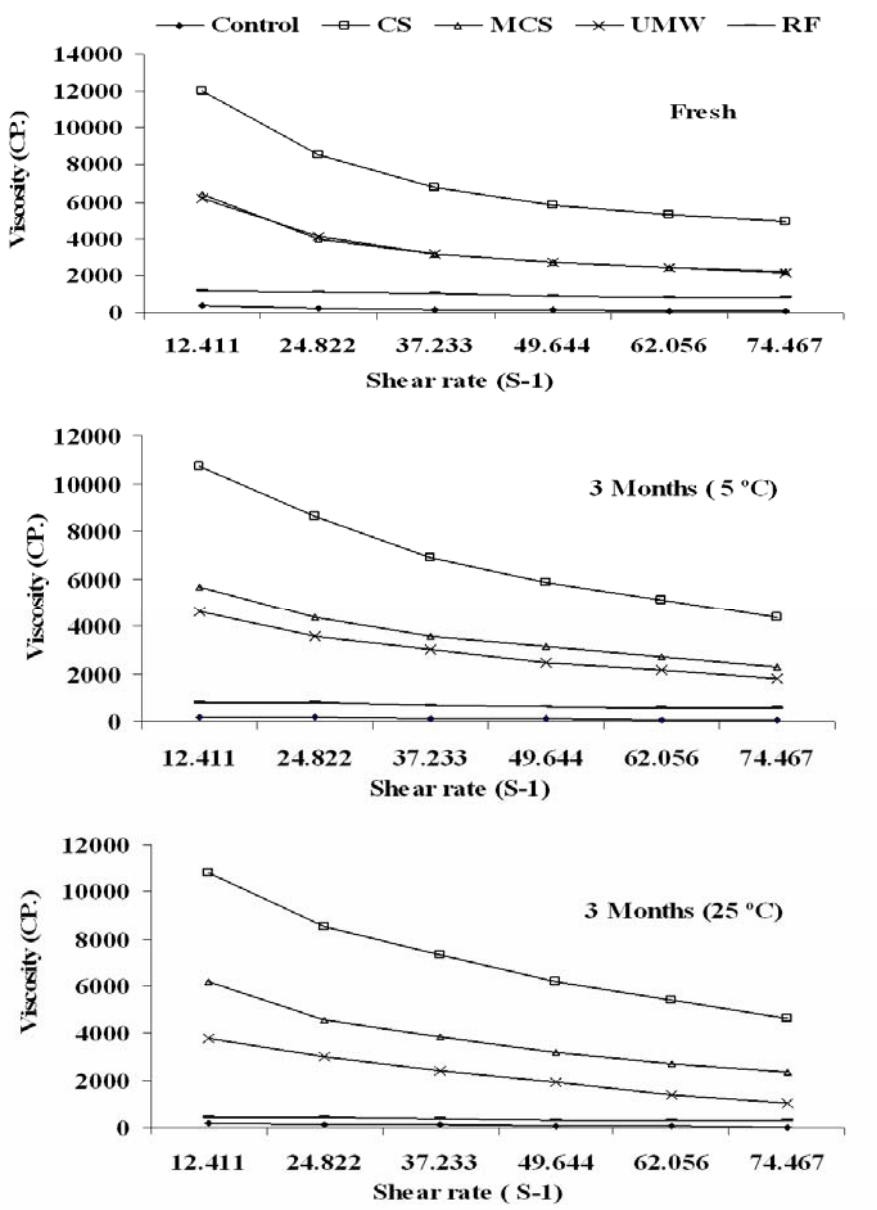

Fig. (1): Viscosity of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents when fresh and during storage.

caused different gel strengths that affected viscosity of the sauces blends (Guinee *et al* 1994). After storage for 3 months sauces with thickening agents showed differences in behaviour of viscosity when stored at 5 ºC or at 25 ºC. Storage decreased in viscosity with different rates in all sauces, although it caused decrease in viscosity values in unmodified wheat starch and rice flour more pronounced at 25 ºC , the decrease were more pronounced at 5 ºC in sauces of corn starch and modified corn starch . On other meaning, corn starch and modified corn starch sauces had a lower viscosity when stored at refrigerator temperature than when stored at room temperature. These could be due to changes occurred in the composition in starches gel matrix and partial protein hydrolysis which affected the state of protein in the emulsion. Other factors like changes in pH values, SN content, action of emulsifying salt, state of protein in emulsion affected the behaviour of viscosity for sauces treatments. With extending the storage period viscosity of processed cheese sauce decreased in control treatment especially at room temperature Younis *et al* (1991 b).

Sensory evaluation

The organoleptic properties of processed cheese sauces with different additives are illustrated in Table (7). Scores of fresh samples indicated that addition of different starches & rice flour to the formula improved the organoleptic properties of the end product. All cheese sauces had a bright & shiny outer appearance. All samples had higher scores than the control. Treatments with corn starch and modified corn starch caused more bright & shiny than the others. The inner appearance, which represents the body and texture of the fresh samples, showed that the addition of modified starch was the best, followed by corn starch when fresh. Samples of modified corn, wheat starches & rice flour had slightly smoother texture than the sample of corn starch. Although the treatment with rice flour had the lowest body & texture score among the treatments with additives, it was better than the control which had a very thin body & texture. Treatments with starch additives & rice flour were much better in flavour than the control which was slightly different in flavour. Modified and corn starches treatments had the highest scores followed by wheat starch. There was a different trend among the treatments during storage of processed cheese sauces up to 3 months at (5ºC) or at room temperature (25ºC). There are some changes happened in

Table (7): Sensory evaluation of processed cheese sauce manufactured using Ras cheese and skim milk powder with different thickening agents when fresh and during storage.

Storage period	Temp.	Character assessed	Treatments* Control	CS	MCS	UMW	RF
Fresh		O. A. (20)	17.5^{Ba}	18.5^{ABa}	19^{Aa}	18.5^{ABa}	18.5^{ABa}
		B&T (40)	30^{Da}	38^{ABa}	39^{Aa}	37^{Ba}	35^{Ca}
		F (40)	37^{Ba}	39^{Aa}	39^{Aa}	38^{ABa}	37.5^{Ba}
		T (100)	**84.5^{Da}**	**95.5^{ABa}**	**97^{Aa}**	**93.5^{BCa}**	**91^{Ca}**
1 Month	5°C	O. A. (20)	17^{Bab}	18.5^{Aa}	19^{Aa}	18^{ABa}	18^{ABab}
		B&T (40)	29^{Ca}	38^{Aa}	38.5^{Aa}	37^{Aa}	35^{Ba}
		F (40)	36.5^{Cab}	39^{Aa}	39^{Aa}	38^{ABa}	37^{BCa}
		T (100)	**82.5^{Dab}**	**95.5^{ABa}**	**96.5^{Aa}**	**93^{Ba}**	**90^{Ca}**
	25°C	O. A. (20)	16^{Bbc}	17.5^{Aab}	18^{Aa}	17^{ABab}	17^{ABb}
		B&T (40)	28^{Ca}	37.5^{Aa}	37.5^{Aab}	36^{Aa}	34^{Ba}
		F (40)	36^{Cab}	38.5^{Aab}	38^{ABa}	37^{BCab}	36^{Ca}
		T (100)	**80^{Db}**	**93.5^{Aab}**	**93.5^{Aa}**	**90^{Bb}**	**87^{Cb}**
3 Months	5°C	O. A. (20)	15^{Acd}	16.5^{Abc}	16^{Ab}	16^{Abc}	15^{Ac}
		B&T (40)	25^{Db}	36.5^{Aab}	36^{Ab}	34^{Bb}	32^{Cb}
		F (40)	35^{BCb}	38^{Aab}	36.5^{ABb}	36.5^{ABb}	34^{Cb}
		T (100)	**75^{Dc}**	**91^{Abc}**	**88.5^{ABb}**	**86.5^{Bc}**	**81^{Cc}**
	25°C	O. A. (20)	14^{Ad}	15.5^{Ac}	15.5^{Ab}	15^{Ac}	14^{Ac}
		B&T (40)	22^{Dc}	35^{Ab}	34^{AB}	32^{BCc}	30^{Cc}
		F (40)	33^{BCc}	37^{Ab}	36^{Acb}	35^{ABc}	31^{Cc}
		T (100)	**69^{Dd}**	**87.5^{Ac}**	**85.5^{ABb}**	**82^{Bd}**	**75^{Cd}**

* See legend to Table (1) for details

O. A. : Outer appearance, **B&T:** Body& texture, **F :** flavour, **T :** Total score

A, B, C: Means with the same letter among treatments in the same storage period are not significantly different.

a, b, c: Means with the same letter in the treatment during storage period are not significantly different.

outer appearance of samples stored at (25ºC), being more shiny. This could be related to some enzymatic changes in samples or related to some degradation happened in the added starches or rice flour. In body & texture the most deterioration occurred was in the treatment of rice flour, it became nearly thin. Sauce with wheat starch had a less deterioration in body & texture while the control treatment had missed the body & texture. All samples had an acceptable flavour except the sample with rice flour which had an odd flavour at the end of storage period at (25ºC). It could be due to the changes in rice oils during storage period especially at room temperature and caused a rancid flavour. Sauce with corn starch had the highest score at the end of the storage period. In general samples stored at refrigerator temperature were better than that stored at room temperature.

Conclusion

The use of thickening agents in processed cheese sauces manufacture were enhanced the properties of the resultant sauces. Sauce with corn starch was much better among all treatments in body & texture , flavour and being more shiny, it was and the best even after storage for 3 months at the refrigerator temperature

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تقييم أفضلية مشهيات من الجبن المطبوخ بإستخدام أنواع مختلفة من المواد المغلظة للقوام

رزق عزب عواد - زكريا محمد رزق حسن - *سهيلة أحمد سعد

قسم علوم الأغذية - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - القاهرة - مصر
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أجريت هذه الدراسة بهدف إنتاج خلطات من مشهيات الجبن المطبوخ ذات جودة عالية وبخامات متوفرة ومناسب للذوق المحلى. تم إستخدام الجبن الرأس واللبن الفرز المجفف مع إضافة أنواع مختلفة من المواد المغلظة للقوام بنسبة 3 % لتكوين الخلطة النهائية بحيث تحتوى على 25% جوامد كلية ، 40 % دهن / المادة الجافة وكانت الأنواع التى تم إستخدامها من المواد المغلظة للقوام هى نشا الذرة ، نشا الذرة المعدل ، نشا القمح غير المعدل ، مطحون الأرز . تم تحليل المنتج النهائى للخواص الكيماوية من حيث : النتروجين الكلى ، النيتروجين الذائب ، الرقم الهيدروجينى ، الملح والرماد والأحماض الدهنية الطيارة الكلية وخواص إنفصال الدهن والخواص الحسية من حيث المظهر الخارجى والقوام والتركيب والنكهة فى العينات الطازجة وأثناء فترة التخزين على درجة حرارة 5° م و 25° م لمدة 3 شهور. لم تلاحظ إختلافات معنوية فى قيم الرقم الهيدروجينى أو الرماد أو النتيروجين الكلى والذائب بين العينات التى احتوت على المواد النشوية المختلفة بينما أظهرت عينة المقارنة بدون إضافة المواد النشوية قيم أعلى للبروتين الكلى والذائب والرماد والملح. وعلى العكس من ذلك فقد أظهرت العينات المضاف اليها المواد النشوية قيماً أعلى من حيث اللزوجة وكانت أعلاهم المضاف اليها نشا الذرة وأقلهم المضاف اليها مطحون الأرز حيث كانت الفروق فى اللزوجة معنوية مع عينة المقارنة. أدت إضافة المواد النشوية المختلفة إلى تحسين قوام وتركيب الناتج وكذلك التفضيل الكلى للمحكمين حيث كانت أفضل المعاملات هى تلك المصنعة بإضافة نشا الذرة وأقلهم تفضيلاً المصنعة بإضافة مطحون الأرز.