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SENSORY EVALUATION OF SKIM MILK BEVERAGE FORTIFIED WITH WHEY PROTEIN CONCENTRATE AND CARROT

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ABSTRACT

Dairy beverage formula was prepared by dissolving 1% whey protein concentrate powder in fresh skim milk ,15%carrot mash as a source for *ß*- carotene, 5%sugar cane and 0.08% dariloid as stabilizer. The mixture was homogenized, heated to 85°C for 15 min. , rapidly cooled , bottled in sterilized stopper glass bottles and cold stored at 5°C±1. Samples were analyzed when fresh for gross composition, then after 3,7 and 10 days of cold storage for acidity, pH, viscosity and sedimentation index . Samples were also evaluated organoleptically by two ways: descriptive method and hedonic method. The results showed that the acidity, viscosity and sedimentation were increased during cold storage. On the other hand, pH had took an opposite trend. Colour took high degree when fresh in both control and treatments and then decreased until the end of storage. Organoleptic descriptive scoring showed that the healthy beverage was acceptable and gained high score when fresh then all the scoring attributes decreased gradually during cold storage until 10 days. Regarding the consumer hedonic questionnaire 35% of the group had answered dislike against 65% answered like this healthy beverage. However, statistical analysis showed no significant difference between means for descriptive and hedonic evaluation at $P<0.05$.

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INTRODUCTION

Whey protein products are characterized by nutritional and functional properties. It can be used in a broad range of dairy and food items to increase and improve the protein content, improve viscosity, act as an emulsifier or substitute fat effect in reduced-fat dairy products. W.P.C. helps in supporting the protein need of heavy athletic training and in maintaining Positive Nitrogen Balance (P.N.B). P.N.B. is the perfect environment for muscle growth repairer.

In recent years a number of foods including fresh vegetables and fruits have been under investigation for their functional and nutritional properties. Most of these investigations mentioned that the active ingredients of carrot are *ß*- carotene and fibbers. *ß*- carotene is known as a powerful antioxidant linked to the prevention of several types of diseases **Bajaj, *et al* (1980) ; Simon, *et al* (1980) and Matuk, *et al* (1996)**. It is a principal element in human vision, bone growth, cell division and reproduction **Downham and Collins (2000) and Foster, (2004). Matuk, *et al* (1996)** mention that *ß*-carotene content in carrot ranges from 850-19000 µg/100g fresh weight.

The nutritional value of a fortified flavored milk beverage is related not only to the presence of milk constitutes but also to the presence of functional and nutritional additives. **Ibrahim, *et al* (2002).** Flavored dairy beverages are classified into two types i.e. those made from whole milk and those from skim or reduced fat milk, low fat

milk beverage have a progressive acceptance by the consumer and have gained a wide appeal throughout the world **Metwally, (1991)**.

The sensory characteristics are an important determinant in the choice of the food products by the consumer. Sensory analysis is the most direct and thus the most valid way measuring the organoleptic characteristics **Piggott, (1995)**.

Sensory evaluation panels can be grouped into three types, highly trained experts, laboratory panels and large consumer's groups. Highly trained experts evaluate food quality and large consumer groups are used to determine consumer reaction to product.

There are three fundamental types of sensory tests being preference/acceptance tests, discriminatory tests and descriptive tests. The first type is based on measuring relative preference and the personal feeling of panelist towards the product directs his response. Discriminatory tests are used to determine whether a difference exists between samples. The panelist does not allow his personal likes and dislikes influence his response. Laboratory difference panels can be used to determined if there is a difference among samples. Descriptive tests are used to determine the nature and intensity of these differences **Stone and Sidel (1998).**

Therefore, skim milk beverage fortified with both W.P.C. powder and carrot mash is considered to be healthy functional product drink.

The aim of the present study is to evaluate production of a functional skim milk beverage fortified with whey proteins concentrate (W.P.C.) powder and carrot mash. Also the feasibility of using the sensory evaluation of both descriptive and hedonic systems on the obtained beverage were considered.

MATERIALS AND METHODS

I-Materials

1-Fresh buffalo raw milk was obtained from the Faculty of Agric. Cairo, Univ. The milk was skimmed using a mechanical separator and the skim milk was analyzed for its chemical composition. Gross chemical composition of skimmilk was : T.S: 10.65%; fat 0.10%; T.P. 4.07%; ash 0.82%; lactose 5.0%; acidity 0.16% and pH 6.7.

2-Carrot and sugar were obtained from local market.

3-Stabilizer: Dariloid 100 (Guar gum, xanthan gum, locust bean gum) produced by Kelco Division of Merck and Co. Inc. U.S.A.

4-Ultrafiltered whey protein concentrate powder was obtained from Bio-pharma Company A.R.E.

Preparation of carrot mash

Fresh carrots were cleaned, washed, peeled, fine grated, boiled for 20min., blended, and stored frozen at -20°C until use.

Preparation of functional milk beverage

Whey protein concentrate powder 1% was dissolved in fresh skim milk with the aid of high speed stirrer. Carrot mash (15%) was added to skim milk followed by sugar cane (5%), Dariloid (0.08%). The mixture was then warmed to 60°C and homogenized by a laboratory hand homogenizer (Ormard, U.K.).

Preliminary experiments were carried out to select the best ratios of both W.P.C. powder and carrot mash. W.P.C. powder was added by the ratio of 0.5,1 and 1.5% .Carrot mash was added by the ratios of 5, 10, 15 and 20%. Sensory evaluation of the fresh beverage indicated that 1% W.P.C. powder and 15% carrot mash were the best ratios which gained the best score values.

The beverage formulas were bottled in sterilized stopper glass bottles then heated to 85°C for 15 min., rapidly cooled and stored at 5°±1°C. The samples were analyzed when fresh and then after 3, 7, and 10 days of cold storage. Three replicates were made from each treatment. 5% Sugar cane and 0.08% Dariloid were added to the control treatment. Beverage samples were analyzed for acidity, pH, T.S., viscosity, sedimentation index , colour and organoleptic properties.

II-Methods

Total solids, was determined according to **IDF (1982)** methods of the fat content, titratable acidity and ash content were determined according the **Ling, (1963).** Total protein content was assessed by kjeldahel method **IDF (1993)**. pH values were measured using a digital pH meter model HANNA AT 4817, equipped with a combined glass electrode. Lactose was determined according to **Nickerson, *et al* (1976)**.

Viscosity of fortified beverage was determined using Zum Viskosimeter type RN-50HZ. Sedimentation index was determined by using centrifugal method described by **Mcdermott, *et al* (1981).**

The colour was determined according to **Hunter (1975)**. Sensory analysis panel for judging flavoured beverages fresh and during storage (3, 7, 10 days) included 20 experienced panelists for appearance (40), colour (20) and flavour (40) by the descriptive analysis according to **Bara-Herczegh, *et al* (2000)** .The Hedonic evaluation (consumer assessment about 60 person) was according to **McEwan, *et al* (1989)** using the following scale:

1- Dislike extremely.
2- Dislike very much.
3- Dislike moderately

4- Dislike slightly.
5- Neither like nor dislike
6- Like slightly.

7- Like moderately.
8- Like very much.
9- Like extremely.

Statistical analysis

The statistical analysis was carried out according to **SAS (1996)**.

RESULTS AND DISCUSSION

Results in **Table (1)** show the titratable acidity and pH values of control and fortified beverage samples when fresh and during cold storage at 5°±1 for ten days. The acidity of the fresh fortified beverage was lower than the control. This decrease may be attributed to the low acidity of carrot mash. However, the acidity gradually increased during storage period to reach 0.35% , 0.26% in control and fortified beverages respectively. This indicates that the acidity development in the fortified beverage was slower due to the added carrot. These results are in agreement with **Naser, *et al* (2002) & Salem, *et al* (2006) and Ahmed, *et al* (1992)**. On the other hand, the pH values took an opposite trend. However, the pH values of treated beverage were higher than the control one either fresh or during cold storage periods.

Table (2) illustrates the viscosity of fortified skim milk beverage when fresh and during cold storage at 5±1°C. It is clear that there is gradual slightly increase in viscosity during the cold storage for ten day as compared with the control beverage. This increase may be attributed to the development of beverage acidity and the more hydration of the added W.P.C. during storage period. These results are in agreement with **Ibrahim, *et al* (2002) and Metwaly (1991).**

The same **Table (2)** indicate the results of sedimentation index of beverage samples when fresh and during ten days of cold storage. Values of sedimentation index of fortified beverage were higher than those of control when fresh or during storage period. The increase in sedimentation index of fortified beverage, mainly due to the added constituents, i.e. carrot mash and W.P.C., in addition to the gradual increase of titratable acidity of both control and fortified beverage samples which make the milk proteins more liable for aggregation.

Table (3) shows the organoleptic judging on the prepared beverage attributes. It is clear that the control beverage had gained higher scores than fortified beverage either fresh or during storage at 5C°±1. The fresh control beverage had gained 20 point for colour whereas after ten days it gained 12 points .On the other hand fortified fresh beverage gained 19 points for colour. Whereas after ten days, it gained 11points. Control beverage gained higher score for flavour 39 point than fortified beverage 38 points and the score decreased gradually until the end of cold storage being 28 and 30 points respectively. The fresh control beverage had gained higher score for appearance being 39 points, while the fresh fortified beverage had gained 37points. Regarding the hedonic evaluation, 10% of consumers dislikes the beverage extremely whereas 5%of the consumers dislike very much, 15% of the consumers dislike moderately and 5% of the consumers dislike slightly. On the other hand 10% of the consumers like beverage slightly and about 15%of the consumers like beverage moderately, 15% like beverage very much and 25%of the consumers like beverage extremely.

From **Tables (4) and (5)** it is clear that no significant difference between means at level of $P<0.05$ during cold storage.

From hedonic method and descriptive method it is clear that the two methods took the same trend. The samples had gained high scores when fresh then gradually decreased until the end of cold storage 5°C±1

Tristimulus Reflectance Colorimeter (TRC), measuring the reflectance L^*, a^* and b^* values , was used to follow the extent of colour changes of beverages during cold storage of ten days . Values of redness (a^*), yellowness (b^*) and lightness (L^*) are illustrated in **Fig. (1) and Fig. (2)** of control

Table 1. Effect of cold storage on acidity and pH of fortified skim milk beverage*

	Storage period days	Control beverage	Fortified beverage
Acidity %	Fresh	0.20	0.18
	3	0.24	0.22
	7	0.30	0.24
	10	0.35	0.26
pH	Fresh	6.85	6.90
	3	6.80	6.86
	7	6.51	6.62
	10	5.77	6.33

*Average of three replicates.

Table 2. Effect of cold storage on viscosity and sedimentation of fortified skim milk beverage*

	Storage period/ days	Control beverage	Fortified beverage
Viscosity (cp)	Fresh	17.40	23.80
	3	17.81	24.00
	7	18.42	24.18
	10	18.80	24.22
Sedimentation index (mm)	Fresh	0.10	0.30
	3	0.20	0.40
	7	0.40	0.60
	10	0.60	0.80

*Average of three replicates.

Table 3. Organoleptic judging (descriptive) of fortified skim milk beverage during cold storage

	Storage period (days)	Control beverage	Fortified beverage
Colour (20)	Fresh	20	19
	3	19	18
	5	17	15
	7	14	13
	10	12	11
Flavour (40)	Fresh	39	38
	3	37	36
	5	36	35
	7	32	33
	10	28	30
Appearance (40)	Fresh	39	37
	3	36	35
	5	34	32
	7	30	30
	10	26	24

Table 4. Least significant difference of fortified beverage using Hedonic procedure

Consumer (average)	Fresh	3 days	7 days	10 days
1	10	9	9	7
2	10	10	10	9
3	10	9	7	7
4	9	9	9	9
5	10	9	9	8
6	10	9	9	7
Means	9.833^{a}	9.333^{ab}	8.8333^{bc}	8.1666^{c}

Means with different letters are significant different ($P<0.05$).

Table 5. Least significant difference of control beverage using Hedonic procedure

Consumer (average)	Fresh	3 days	7 days	10 days
1	9	8	7	6
2	8	7	7	5
3	9	7	8	6
4	7	8	6	5
5	8	8	6	5
6	9	7	7	6
Means	8.33^{a}	7.33^{b}	7.33^{b}	5.66^{c}

Means with different letters are significant different ($P<0.05$).

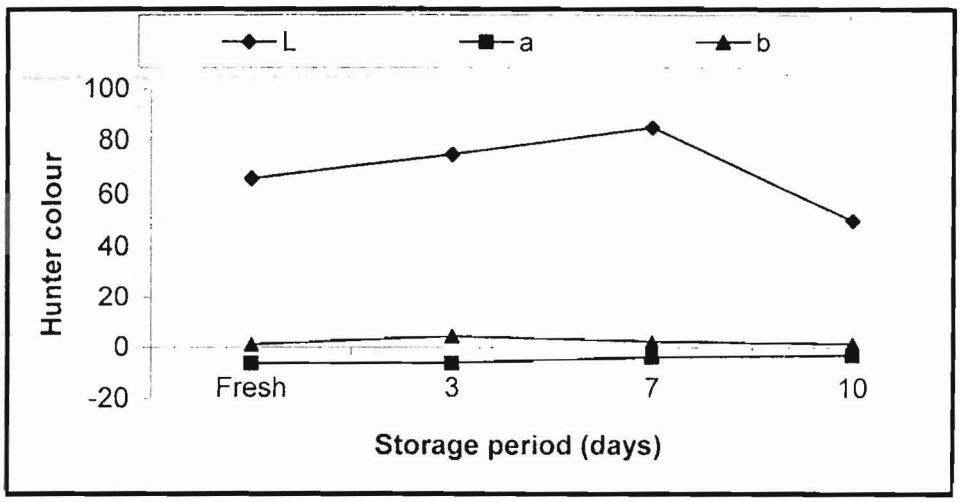

Fig. 1. Effect of storage period on hunter colour values of control beverage
(a) Redness, (b) Yellowness and (L) Lightness

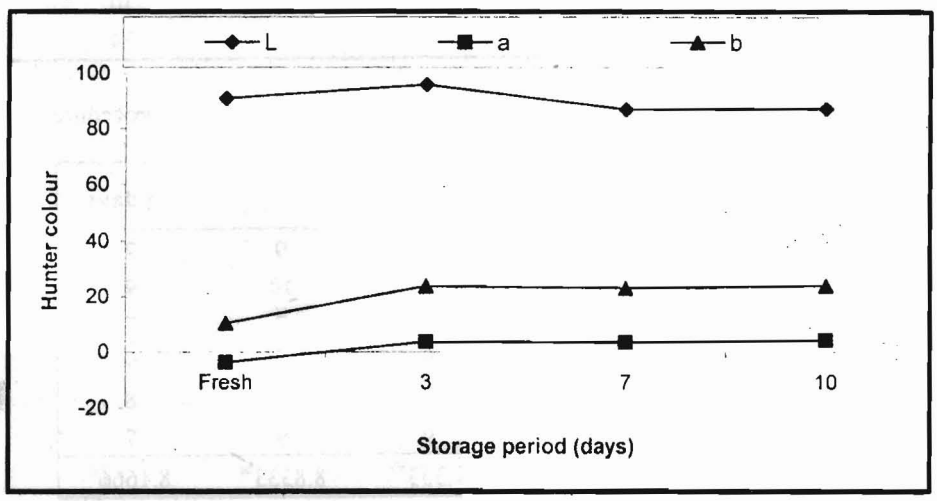

Fig. 2. Effect of storage period on hunter colour values of fortified beverage
(a) Redness, (b) Yellowness and (L) Lightness

and fortified beverage. From **Fig. (1)** it can be observed that the lightness (L^*) of control beverage had the highest values followed by yellowness (b^*) and finally redness (a^*) than the fortified beverage **(Fig. 2)**.The lightness (L^*) of control beverage increased gradually until seven days then decreased until ten days. The redness (a^*) decreased until three days and still the same until ten days. Yellowness (b^*) took the same trend. **(Fig. 2)** shows the effect of storage period on hunter colour values of fortified beverage. The lightness increased until three days then decreased at the seventh day then still the same until ten days. Yellowness increased until the third day then still constant up to the ten days .The redness took the same tread.

CONCLUSION

Consumer hedonic test on skim milk beverage samples exhibited no significant differences between panelists judging .Thus any of the tow tests can be successfully used in sensory evaluation.

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حوليات العلوم الزراعية
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التقييم الحسي لمشروب اللبن المنزوع الدسم والمدعم بمركز بروتينات الشرش والجزر

[٣٣]

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تم تحضير مشروب صحي بإذابة مركز بروتين الشرش فى لبن فرز بنسب متفاوتة ٠,٥ ، ١ ، ١,٥% وتم إضافة عصير جزر كمصدر لبيتا كار وتين وكمضاد للأكسدة ومصدر للألياف وفى نفس الوقت كمصدر للنكهة والطعم بنسب مختلفة ٥،١٠،١٥% وتم إضافة ٥% سكر ، ٠,٠٨% Dariloid كمثبت وتم عمل تحكيم حسى و كانت افضل النسب المتحصل عليها ١% مركز بروتين شرش و١٥%عصير الجزر و٥% سكر و٠,٠٨% Dariloid وتم عمل تجنيس للمخلوط وتسخين على درجة حرارة ٨٥°م مدة ١٥ق والتبريد السريع والتعبئة فى عبوات معقمة والتخزين فى الثلاجة على درجة حرارة1 ±٥°م ثم عمل التحليل الكيماوى والحسى على فترات تخزين مختلفة طازجة وبعد ١٠,٣,٧ أيام بالنسبة للحموضة, pH, ودرجة الزوجة و معدل الترسيب و اللون وأيضا التحكيم الحسى بطريقتين تحكيم الخبراء(Descriptive) و(Hedonic) واستبيان المستهلكين ولقد أشارت النتائج الى: زيادة كلا من الحموضة والزوجة خلال فترة التخزين بينما أخذ الـ pH الاتجاه المعاكس و ايضا معدل الترسيب اخذ فى الزيادة مع زيادة مدة التخزين بينما اخذ اللون اتجاة معاكس خلال فترة التخزين اما بخصوص التحكيم الحسى فلقد وجد ان حوالى ٣٥% من المحكمين كانت المشروبات غير مقبولة بالنسبة لهم فى حين ان حوالى ٦٥% كانت مقبولة ولقد اشارت نتائج التحليل الأحصائى الى انة لا توجد فروق معنوية بين حالة استبيان المستهلكين و تحكيم الخبراء عند مستوى معنوية ٠,٠٥ >P.

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