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PRODUCING BISCUITS ENRICHED WITH VITAMIN A AND IRON BY USING SWEET POTATO AND PUMPKIN POWDER FOR PRIMARY SCHOOL CHILDREN.

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ABSTRACT

Biscuit produced from wheat flour (WF 100%) supplemented with sweet potato powder (SPp) and pumpkin powder (Pp) at three level (5,10and15%) to enrich vitamin A and replacement sugar with black strap molasses to produce biscuits enriched with iron. The products were analyzed chemically and organoleptic evaluation was carried out. The results indicated the high contents of vitamin A found in Pumpkin powder (Pp) followed by sweet potato powder (SPp) with12663.67 and 8551.33 IU/100g respectively . As a result of supplemented sweet potato powder (SPp) and pumpkin powder (Pp) to wheat flour (WF 100%) gave higher vitamin A content (1041.33,1777.33,1041.33 and 1458.33 IU/100g respectively on other biscuit samples. The lowest level of vitamin A supplemented both of 10 % with sweet potato powder (SPp) and pumpkin powder (Pp) were 666.67 and 877.33 IU /100 g respectively in biscuit formula. On other hand iron content was higher in biscuit formula with black strap molasses than control. The percentage of iron content was increased from 1.40 to 5.90 mg /100g respectively for all biscuit formula. Evaluation of organoleptic properties clearly indicated the best tow samples, the supplemented with 10% sweet potato powder (SPp) and 5%pumikin powder (Pp) .showed that the best overall acceptability and ability value were (76.04 and 91.40 %), The quantities of this two chosen samples covered the daily requirement of vitamin A for children (9- 12 year) showed that 137.11g and 192.1g from tow best samples .Supplementing both of sweet potato and pumpkin powder to wheat flour improved protein efficiency ratio and biological value (2.91, 2.86 ,80.52, 79.99). finally, results indicated that Supplementing both of sweet potato and pumpkin powder to wheat flour at different levels with replacement sugar by black strap molasses were optimal for producing of biscuits riches in vitamin A and iron content .

Keywords: Biscuit, Vitamin A, Iron Sweet, Potato, Pumpkin, Blackstrap, Molasses, Fortification.

INTRODUCTION

Deficiencies of iron and vitamin A are prevalent worldwide and can affect the mental development and learning ability of schoolchildren , malnutrition is recognized as an important public health problem affecting > 2 billion people worldwide., micronutrient deficiencies can have significant negative consequences on health and economic development (UNICEF/MI, 2004). Malnutrition is considered a common health problem in Egypt, which the children are the most vulnerable group of malnutrition (Rashed, 2002).

Strategies to control vitamin A deficiency include dietary diversification , food production of ß- carotene rich crops , such as orange

fleshed, sweet potato . the consumption of ß- carotene increased the V.A intake of Kenyan women and children .

Vitamin A or carotenoids (provitamin A) required for growth, development and physiological functions, or vitamin A in prevention of blindness which is widely recognized (Macleran, 1986 and Sommer 1995).

Provitamin A (carotenoids) are a major source of dietary vitamin A in a large proportion of the world population and β-carotene (βc) is the most common provitamin A carotenoids (IVACG, 1999).Iron is an essential component of hemoglobin, the oxygen transporting protein blood (Bothwell *et al.*, 1979).iron deficiency is the result of long-term negative iron balance (UNICEF/UNU, 2004).

Sweet potatoes are highly nutritious vegetables; however sweet potato consumption is progressively declining especially in industrialized nations. Grabowski *et al.*, (2006) suggested the use of sweet potato into dried powder as functional ingredient in food system. Also pumpkin powder is a good source of carotene, minerals, vitamins and other substances that are beneficial to health. These facts lead to the processing of pumpkin into various food products (Jun *et al.*, 2006). Moreover supplementation with black strap molasses caused an improvement in all the quality characteristics of the product and enhance iron content (Makhlouf, 1991).

A major advantages of using biscuit is a carrier for micronutrients is that biscuit is regard as snake than a meal and therefore unlikely to replace meals given to child home and also it is easy to disrupts , no preparation , long self life . (Asal,2004)

The aim of this study was to supplement biscuits with sweet potato and pumpkin powder as vitamin A sources for primary school children. Also to replace sugar with black strap molasses as source of iron.

MATERIALS AND METHODS

Materials:

Wheat flour *Ttritucum vulgara* (72% extraction) , Sweet potato and Pumpkin (*Ipomoea batatas*) and (*Cucurbita moschata* Duch)) were obtained from El-Mansoura local market.

Black strap molasses, sugar, salt, vanillin, baking powder and vegetable shortening were obtained from local market.

Methods:

Preparation of sweet potato and pumpkin powder:

Fresh sweet potato and each fruit from pumpkin were cleaned and washed with distilled water, sweet potato peeled and cut into slices and soaked in boiling water for 15 min then cooled with distilled water and dried in an air oven dryer 50-60 ^{0}C for 24hr, and then ground to 40 mesh sieve .

Pumpkin was cut into sections, after removal of seeds, peeled sections were cut into small pieces that dried in an air oven dryer 40-50 ˚C for 24hr, and finally milled in order to pass through a 30 mesh sieve.

Preparation of biscuits:

Control Biscuits sample were prepared included 100 g of ingredient with baking powder 3g, water 26.1 ml, shortening 20g, salt 1g and sugar 40g according to the method described by Abdel-Magied (1991). The supplemented biscuits were prepared using the same formula expect for replacement sugar with blackstrap molasses and wheat flour (72%) with sweet potato or pumpkin flour at 5,10and 15 % (table 1). All Different biscuits formula were baked at 230 C for 10: 15 min then cooled and packaged in poly ethylene bags for further investigation .

Table (1): Biscuits formula from wheat flour, sweet potato and pumpkin powder.

Samples / Ingredients (%)	Control (1)	Control (2)	1	2	3	4	5	6
Wheat flour(w.f)	100	100	90	90	85	85	75	75
Sweet potato powder(S.P.p)	-	-	10	-	10	5	10	15
Pumpkin powder(P.p)	-	-	-	10	5	10	15	10

Chemical analysis:

Moisture, crude protein, crude fat, crude fiber and total ash were carried out according to methods of A.O.A.C. (2000).While Total carbohydrates were estimated by difference, food energy was calculated by multiplying carbohydrates, fat and protein contents by 3.87, 8.79 and 4.27 K. cal/g., respectively, according to Radi and Arous (2000).

Vitamin A was determined according to the method of A.O.A.C. (2000). and iron measured according to Luten *et al.*, (1996).

Amino acids were determined in the acid hydrolysate according to the method described by Pellet and Young (1980), using Backman amino acid analyzer.in Alexandria central lab. Faculty of agriculture, Alex. University

Protein efficiency ratio (PER): was estimated using the equation

PER = 0.684 + 0.456 (Leucine) – 0.047 (praline). according to Alsmeyer *et al.* (1974). Biological value (BV) was calculated by the following equation.

BV = 49.9 + 10.53 (PER). According to Mitchell and Block (1946).

Organoleptic Evaluation:

Biscuit samples were evaluated organoleptically by 10 panelists for appearance, color, thickness, shrinkage, taste and odor according to the method described by Smith (1972).

Physical Measurements :

Physical measurements were carried out according to Abdel-Magied (1991) as following, thickness, Diameter (both average of 15 biscuits) (cm), weight of 15 biscuits (g) and stock height of 15 biscuits (cm). The diameter and thickness of biscuits measured by Plano meter to the nearest mm.

Statistical Analysis : Statistical analysis of the data was performed using the statically program (spss computer soft ware)

RESULTS AND DISCUSSION

The proximate chemical composition of raw material used in making biscuit were shown in table (2), moisture content were 4,54 and 8,69 % in both of sweet potato and pumpkin powder . Wheat flour had the highest percentage of protein content 12.66% followed by sweet potato 4.50% and pumpkin powder 3.80% .

Vitamin A in both of pumpkin powder and sweet potato powder were 12663.67 and 8551.33 IU/100g respectively. These results were in agreement with those obtained by (Ally,. 2001).

It could be observed that sweet potato powder had the highest amounts of carbohydrate (80.47%) meanwhile the amounts of carbohydrate in pumpkin powder was (75.62%). on the other hand, the high ash percentages was found in pumpkin powder followed by sweet potato and wheat flour were (5.39, 3.87and 0.55%) respectively. the results also revealed that the highest amounts of fiber found in sweet potato followed by pumpkin powder and wheat flour (4.94, 3.50and 0.58%) .

Strap molasses has high amount of Fe content (28 mg/100gm). In compare with sweet potato (4.25) and pumpkin (3.55)mg/g. These results were in agreement with those obtained by, Heinonen etal ., 1989 ; Grabows *et al.*, (2008) and Noor *et al.*, (2009).

Table (2): Proximate composition of raw material used in making biscuit (calculated on dry weight basis).

Samples	constituents							
	Moisture	Crude protein	Crude fat	Ash	Fiber	Carbohy-drate	Vit.A (IU/100g)	Fe (mg/ 100g)
Wheat flour	12.66±0.66	10.53±1.45	1.45±0.96	0.55±0.32	0.58±0.32	76.89	-	1.34
Sweet potato	4.54±1.64	4.50±0.73	1.67±0.01	0.87±0.39	4.94±0.77	80.47	8551.33	4.25
pumpkin	8.69±1.49	3.80±0.55	3.00±0.02	5.39±0.82	3.50±1.32	75.62	12663.67	3.55
Black strap molases	23.7±2.13	-	-	4.33±1.35	-	-	-	28

Carbohydrate was calculated by difference

Table (3) represented the chemical composition of different biscuits formula processed by using potato and pumpkin powders with different levels. Moisture content of supplemented biscuits ranged from 5.23 to 7.67%.As a result of adding sweet potato and pumpkin powder to wheat flour.

Ash and fiber content of biscuit formula tended to increase by increasing the level of added fortified materials .Concerning to fat , there is a gradual increase on the fat content when compared with un fortified formula this may be attributed to its high content of fat before addition to the flour .

Vitamin A content was higher in formula contained 10% sweet potato and 10% pumpkin (666.67, 877.33 IU/100g).. These results are in agreement with those reported by Singh and Bradbury (1988) ; Hussein (2001) and Puppo *et al.,* 2005)

Concerning Fe content , results showed that the higher percentage (5.20 and 4.90) was obtained for biscuits formula with sweet potato 10% and sweet potato powder 10%+pumpkin powder 15% , it could be observed that the replacement of sugar with black strap molasses increase the content of Fe from 1.40 mg/g in control sample to be more than 5mg/g. after replacement therefore , black strap molasses enhance the content of iron of biscuits formula this result agree with those obtained Abde el mageed (1995)

Table (3): Chemical composition of biscuits made from wheat flour (72% extract.) fortified with sweet potato and pumpkin .

samples	constituents							
	moisture	Crude protein	Crude fat	Ash	Fiber	Carboh-ydrate	Vit.A (IU/ 100g)	Fe (mg/ 100g)
100% W.F	5.78+ 0.17	10.53+ 0.8	12.33+ 0.22	2.50+ 0.49	0.34+ 0.13	70.38	-	1.40
100% W.F With molasses	5.66± 0.67	8.77± 0.32	13.33± 0.22	2.50± 1.40	050± 0.23	69.24	-	5.40
90% W.F + 10% S.P.p	5.55± 0.49	7.08± 0.32	13.30± 0.88	2.50± 1.13	0.86± 012	70.71	666.67	4.90
85% W.F + 10% S.P.p + 5% P.p	6.33± 1.17	7.89± 0.32	14.00± 0.67	2.50± 1.88	1.00± 0.38	68.28	1041.33	4.80
75% W.F + 10% S.P.p + 15% P.p	6.37± 1.05	6.69± 0.43	14.00± 0.89	2.50± 1.30	1.00± 0.34	69.44	1777.67	5.20
90% W.F + 10% P.p	5.23± 1.04	7.67± 0.6	12.89± 0.94	2.00± 1.25	0.51± 0.30	71.70	877.33	4.70
85% W.F + 10% P.p + 5% S.p.p	6.43± 1.01	7.48± 0.32	13.16± 0.34	1.50± 1.32	1.00± 0.18	70.43	1041.33	5.30
75% W.F + 10% P.p + 15% S.p.p	7.76± 1.48	7.30±0.6 6	12.97± 0.11	2.50± 0.46	1.00± 0.23	68.47	1458.33	5.40

- **Carbohydrate was calculated by difference**

The data presented in table (4) that biscuits formula contained wheat flour + 10% sweet potato powder and its mixture with 5 and 15% pumpkin powder the best overall acceptability from 74.7 to 72.30% .

Addition of 10% sweet potato powder and 10% pumpkin +15% sweet potato powder to wheat flour showed the best ability values (91.40 and 89.85) respectively addition of pumpkin powder to sweet potato improved colour , taste and odour in all produced biscuits under investigation . these were in agree with (Hussien 2001; Lee *et al.,* 2002 and Ponjanta *et al.,* 2004)

Table (4): The organoleptic evaluation of biscuits made from wheat flour and sweet potato and pumpkin powder and its mixtures.

Samples	Appearances (10)	Color (15)	Crispines (15)	Taste (15)	Odor 15)	Total (100)	Ability Value %
100% W.F (72% extra.)	8.98	13.12	13.32	12.25	12.50	83.67	100.0
With molasses							
100% W.F (72% extr.)	8.50	12.66	12.36	12.25	11.95	83.19	100.0
90% W.F + 10%S.p.p	7.03	10.98	11.00	11.00	11.88	72.30	88.11
85% W.F + 10% S.p.p+ 5% P.p	7.55	10.25	10.31	11.84	12.57	76.04	91.40
75% W.F + 10% S.p.p + 15% P.p	7.29	9.25	7.51	7.37	12.00	68.88	82.29
90% W.F + 10% P.p	8.24	11.33	11.67	10.11	11.23	74.61	88.93
85% W.F + 10% P.p + 5% S.p.p	8.50	12.75	9.25	10.75	11.00	74.75	89.85
75% W.F + 10% P.p + 15% S.p.p	8.55	12.20	10.31	9.84	10.30	74.72	89.82

Data in table (5) showed the baking quality parameters of produced biscuits , detectable increase were observed in biscuits diameter and thickness after baking .

Table (5): Baking quality parameters of biscuits made from wheat flour mixed with sweet potato and pumpkin .

Samples	Biscuits before baking		After baking					
	*Thick-ness (cm)	*Diam-eter (cm)	*Thic-kness (cm)	*Diameter (cm)	Spread ratio	**stock Weight (gm)	** stock high (cm)	Stock high/ stock weight %
100% W.F	0.40	5	0.66	5.20	7.87	94.85	11.25	12.00
With molasses								
100% W.F	0.40	5	0.75	5.40	7.20	88.30	10.55	12.00
90% W.F +10% S.p.p	0.40	5	0.97	5.20	5.36	93.35	9.80	10.00
85% W.F + 10% S.p.p + 5% P.p	0.40	5	0.69	5.20	7.54	96.85	12.20	13.00
75% W.F + 10% S.p.p + 5% P.p	0.40	5	0.68	5.20	7.65	102.25	10.80	11.00
90% W.F+10% P.p	0.40	5	0.75	5.00	6.67	97.25	10.20	10.00
85% W.F + 10% P.p + 5% S.p.p	0.40	5	0.62	5.30	8.54	98.50	10.30	10.00
75% W.F + 10% P.p + 15% S.p.p	0.40	5	0.83	5.40	6.50	100.55	10.90	11.00

*** Average of 15 biscuits** **** Based on 15 biscuits**

The addition of sweet potato powder with the percentage of 10% and pumpkin of 5% for white flour recorded the highest high stock/ stock weight % were 13 and 11.00% respectively , but the addition of 10% pumpkin powder and 5% sweet potato powder to wheat flour increased the spread ratio for formulated biscuit from 7.20and 7.87% to 8.54%

The data indicated that sample of biscuits contained 85% wheat flour + 10% pumpkin + 5% sweet potato. Was the best biscuit formula for spread ratio.

The changes in baking properties may be due to the changes in the quality and quantity of protein with the added ingredients and also attributed to gas retention of dough during baking process (Sai *et al.,* 1997 and Hussien *et al* ., 2010)

It was noticed from table (6) the protein value in control (100% w.f) for biscuit was 8.67 and in molasses sample was 8.77% **.** Data in the same table showed the essential amino acids represented 46.53 and 45.17 % and non essential amino acids were 53.46and 55.43 % in both of control biscuit samples.

The results indicated that produced biscuit formula with 85% flour +10% sweet potato powder +5% pumpkin powder represented the highest amount of essential amino acids was 47.53 and the biscuit formula contained 85% flour 10% pumpkin powder +5%sweet potato powder represented essential amino acids with the percentage of 40.68%

Increasing in essential amino acids in produced biscuits from wheat flour and different mixture due to the variations in the original amino acids and its mixtures, but the decreased of amino acids at different rated due to Millard type browning reaction namely the reaction of sugar with amino acids during baking process. (Hussien *et al .,* 2010)

Table (6): Amino acids content of chosen biscuits made from wheat flour (72% extraction) and its mixtures (g/100g. protein).

	Amino acids	Biscuits with different formula			
		1	2	3	4
Essential-amino Acids (E.A.A)	Lysine	8.93	8.06	8.91	12.50
	Methioine	0.37	0.15	0.33	0.41
	Leucine	5.04	5.18	6.10	5.40
	Isoleucine	2.91	3.05	3.87	3.03
	Phenylalanine	2.87	3.44	3.08	3.01
	Argnine	2.69	3.32	2.40	2.23
	Threonine	5.48	4.49	2.55	6.13
	Valine	3.83	4.00	3.99	0.82
	Histidine	9.82	8.59	9.45	14.01
	Total	41.94	40.28	40.68	47.54
Non-essential amino acids (N.E.A.A)	Tyrosine	2.71	2.97	3.13	2.29
	Cystine	0.06	0.10	0.22	0.22
	Alanine	2.41	2.58	2.64	2.89
	Glycine	2.02	2.03	2.34	2.09
	Proline	12.03	12.55	11.88	6.12
	Serine	3.99	3.27	3.84	4.47
	Aspartic acid	3.00	4.47	4.78	4.99
	Glutamic acid	21.46	21.46	20.19	19.40
	Total	48.19	49.43	49.02	42.47
	Protein %	8.67	8.77	7.48	7.30

1: control 100% w.f **2: control w.f100% + molasses**
3: 85% W.F+10 S.p.p +5% P.p **4: 85% W.F+10% P.p +5% S.p.p**

It can be concluded from data tabulated in table (7) that the best chosen formula which cover the daily requirements of vitamin A, iron, essential amino acids, and calories for children from (9to 12 years).

Samples can be arranged as the following descending manner:

- The first formula composed of 85% wheat flour + 10% pumpkin + 5% sweet potato. And the data indicated that 192.1g covered the daily requirements of vitamin A, and 101.8% of iron.
- The second formula contained were 85% wheat flour + 10% sweet potato + 5% pumpkin and indicated 137.11g covered the daily requirements of vitamin A, 108.4% of iron.

Both protein efficiency ratio (PER and BV) of supplemented biscuit in compare with control sample

The proximate composition of biscuits provided a good caloric value i.e. 552.9 and 559.6 K.cal/100g. The results are in agreement with those reported by **Johnson *et al.*, (1985) and Baker (1997).**

Table (7): The quantities of different biscuit formula covered the daily requirement of vitamin A , iron (Fe), essential amino acids (EAA), calories and biological value (BV) for children (9-12 years).

Measurements	*FAO/ WHO/ UNU	Biscuits with different formula							
		1		2		3		4	
		A	B	A	B	A	B	A	B
Vit.A (IU/100g)	2000	-	-	-	-	1041.33	192.1	1458.67	137.11
Fe mg/100g	10	1.40	714.3	5.40	185.2	5.30	188.7	4.80	208.2
Lysine	2.88	0.77	374	0.71	405.6	0.69	417.4	0.91	316.5
Leucine	2.88	0.44	654.5	0.45	640	0.45	640	0.39	738.5
Isoleucine	1.81	0.25	724	0.27	670.4	0.29	624.1	0.22	822.7
Valine	2.31	0.33	700	0.35	660	0.30	770	0.06	3850
Histidine	1.13	0.85	132.9	0.75	150.7	0.71	159.1	1.02	110.8
Theronine	2.25	0.47	478.7	0.39	576.9	0.19	118.4	0.45	500
Total portein	16	8.67	184.5	8.77	182.4	7.48	213.9	7.30	219.2
Calories/100g	2400	428.5	560.1	434	553	434.08	552.9	428.9	559.6
PER		2.42		2.46		2.91		2.86	
BV		75.35		75.80		80.52		79.99	

***FAO/WHO/UNU daily requirements for children (9-12 years).**
FAO/WHO/UNU (1984).
UNCEF/UNU/WHO/MI, (1999)
A- Content in sample.
B- Quantity covered the daily requirement.
1- 100% wheat flour (72%)
2- 100% wheat flour (molasses).
3- 85% wheat flour + 10% pumpkin + 5% sweet potato (molasses).
4- 75% wheat flour + 10% Sweet potato + 5% pumpkin (molasses).

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إنتاج بسكويت مدعم بفيتامين ا والحديد باستخدام مسحوق البطاطا والقرع العسلي لأطفال المدارس الابتدائية

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تم إنتاج بسكويت من دقيق القمح ومدعم بخلطات من مسحوق البطاطا الحلوة ومسحوق القرع العسلي بنسب 5-10-15% من دقيق القمح لزيادة نسبة فيتامين (ا) واستبدال السكر بالعسل الأسود لإنتاج بسكويت غني بالحديد .وأجريت التحاليل الكيمائية والتقديرات الحسية وأوضحت النتائج ارتفاع محتوي مسحوق القرع العسلي من فيتامين (ا) ثم مسحوق البطاطا وكانت النسبة (12663.67و 8551.33) وحدة دولية على التوالي. وفي جميع الخلطات تحت الدراسة ارتفع محتوها من فيتامين (أ) (1041.33 ، 1777.67 ، 1041.33 و 1458.33 وحدة دولية) بينما كانت اقل نسبة لفيتامين (1) في العينات المحتوية علي 90% دقيق قمح + 10% من كلا من مسحوق (البطاطا الحلوة و القرع العسلي) .

و كذلك ارتفع محتوى الحديد لجميع العينات بعد استبدال السكر بالعسل الأسود مقارنة بالعينة الكنترول . وكانت نسب الزيادة في محتواها من الأملاح المعدنية (الحديد) من (40،1الى 40،5 ٪) لكل خلطات البسكويت .

وأوضحت نتائج التقييم الحسي وجد أن أفضل عينتين هما 10% من مسحوق البطاطا مع 5 ٪ مسحوق القرع. وأظهرت أن نسبة القبول والقابلية هى (76.04) و (91.40) علي التوالي . بينما العينة الاخري المحتوية علي 10 ٪ من مسحوق القرع العسلي مع 5% من مسحوق البطاطا الحلوة وأظهرت القابلية والقبول(74.75) (89.85).% وقد وجد ان الكميات التى تغطى الاحتياجات اليومية من تلك العينتين المختارة من فيتامين (أ) لأطفال المرحلة الابتدائية في المرحلة العمرية من 9: 12 عام هي 137.11 جم و 192.1 جم .

من النتائج السابقة اتضحت تحسن نسبة كفاءة البروتين والقيمة الحيوية (2.91و 2.86) (80.52 و 79.99) علي التوالي نتيجة للاستبدال في العينين السابقتين مقارنة بالكونترول

وأوضحت النتائج أن الاستبدال بمسحوق البطاطا والقرع العسلي بالنسب المختلفة والسكر بالعسل الأسود مناسب لانتاج بسكويت غني بمحتواه من الحديد وفيتامن (1) لاطفال المدارس ..

قام بتحكيم البحث

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