Utilization of Pumpkin Powder to Enhance the Nutritional Value and physical properties of Biscuits

الإستفادة من مسحوق القرع العسلي لتحسين القيمة الغذائية والخصائص الفيزيائية للبسكويت

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Abstract

Pumpkin has a high nutritional value of protein ,fiber, carbohydrates and antioxidants. So the present study aims to investigate the chemical,mineral, β carotene and vitamin E contents ,likewise ,physical and sensory properties of wheat biscuits and biscuits fortified with (10%,20%) peel and pulp of pumpkin. The results revealed that the gross chemical composition of biscuits fortified with 20% peel of pumpkin powder was recorded a high ratio in protein 10.47 %;but Wheat flour biscuit was recorded the lowest value in protein 9,02 %and crude fiber 0,21% ; while, biscuits fortified with 10% pulp had the lowest value of crude fat 13.45%on dry weight basis. Results also indicated a more significant difference in mineral content between biscuits fortified with peel and pulp of pumpkin. In addition biscuits with 20% peel was recorded the highest values in Ca ,Fe, Mg (285.33) mg/100g .The highest □-Carotene in biscuits fortified with 20% pulp pumpkin was recorded 1,20 mg/100g, also the lowest □-carotene in wheat flour biscuit was recorded (0.34 mg/100g) . while, physical and sensory properties scores had observed significantly higher in biscuits fortified with 20% pulp pumpkin powder. Therefore it could be recommended to utilize pumpkin in different food formulas to enhance the nutritional value .

Key words: Pumpkin, Chemical composition ,Minerals content, Vitamins ,Biscuits.

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Introduction

Biscuits are the most popular bakery food product consumed by nearly all levels of society *Lee et al.,(2008)* . They are rich in carbohydrates, fat and energy, but their content of fibers, vitamins and minerals makes biscuits a non-integrated diet for daily use. In order to increase the nutritional value of some baked products like biscuits, cakes, cookies and pancakes to improve their overall quality, it is achievable by adding pumpkin flour and fresh fruits to the mixture during the manufacturing process *Shamaail and Saher,(2020)*.

Pumpkin belongs to the *Cucurbitaceae* family generally ،characterized by climbing herbaceous vine with tendrils grown widely all over the world and pumpkin is a rich source of nutrients that may help improve products *Kasaye and Jha (2015)*. It has been used traditionally in many countries as medicine such as India, Mexico, Brazil, America and Argentina *Jia et al.,(2003).*

Pumpkins importance as a food source for humans stems from its containing many important nutrients such as carbohydrates, fibers *shamaail and saher,(2020)* . Pumpkin also included the various source of carotenoids *Caili,(2006).*which have important roles in nutrition as provitamin A (antioxidant). .Pumpkin is high in β-carotene, which gives its yellow or orange color, Some of its common uses in most countries are for diabetes,cancer and treating internally as well as externally for management of worms and parasites .However, It is commonly consumed as a vegetable *Bhaskarachary et al.,(2008)*.

These biologically active components have shown to be a wide range of medicinal properties such as anti-diabetic ,antioxidant activity ,anti-carcinogenic effect, anti-microbial effect ,It has been investigated through a number of animal models,cell culture studies and clinical trials *Zhou et al.,(2007) and Yadav et al.,(2010)*.

β carotene is a precursor of vitamin A and it plays a vital role in the prevention of cancer and chronic diseases due to its antioxidant activity *Kim et al., (2012)*.Also,vitamin E is the major lipid-soluble component in the cell antioxidant defense system and is exclusively obtained from pumpkin*Saliha et al.,(2014).*

The objective of this study was the utilization of pumpkin powder to enhance the nutritional value and physical

properties of biscuits supplemented with (10% and 20%) peel and pulp of pumpkin .

Materials and Methods

Materials

Source of Samples

10 kg of pumpkin fruit was obtained from the Research Farm of Agriculture, Assiut University, season 2019.

Wheat flour (72% extraction) ,sugar powder,sodium chloride , margarine and baking powder were purchased from the local ammonium and sodium bicarbonate were ،market , Assuit city purchased from El-Gomhouria company of Drugs in Assuit.

Preparation of pumpken

Pumpkin was washed ,cut , peeled, cleaned of seeds and sliced .The pumpkin pulp was stored in the freezer at 4□c until the time for analysis. The collected peels were dried in an electrical oven at 55□c for 12 hours and grounded to obtain powder then stored until analysis *Ramadan et al.,(2010).*

Technological process

Biscuit formula and ingredients

Control biscuit dough was prepared according to the formula presented in Table (1). The supplemented biscuits with (peel and pulp) pumpkin powder were prepared using the same formula except for replacing the wheat flour with 10%,20% of (peel and plup) pumpkin

Table (1) :Formula Biscuits *

Ingredients	**Quantities** (g)
Wheat flour (72%extraction)	100
Sugar powder (g)	30
Sodium chloride (g)	1
Ammonium bicarbonate (g)	1
Margarine (g)	20
Sodium bicarbonate (g)	0.5
Baking powder (g)	0.3
Water (ml)	16

***sayed (2011)**

Dough preparation of biscuits

Powdered sugar and margarine were creamed in Braun Mixer with a flat beater for 2 minutes at 5 rpm Then sodium chloride, sodium carbonate, ammonium bicarbonate were dissolved in water and then added to the cream mixture and mixed for 5 minutes at 125 rpm to obtain a homogenous cream. Baking powder was added slowly to the flour then added to the mixture slowly and mixed for 2 minutes to obtain biscuit dough.

Preparation of biscuits

The dough was sheeted to the thickness of about 3mm using Atlas Brand Rolling Machine .The sheeted dough was cut into round shape using a 45 mm diameter cutter and baked on an aulminium tray in an electric oven at 180 ^{o}C for 6 minutes .The biscuit was cooled for 30 minutes ,packed in polyethylene bags,stored under desiccnation ***Vatsala and Haridas (1991) ;Manohar and Rao (1997).***

Preparation of different blends of biscuits

Blends biscuits were prepared using wheat flour 72% extraction rate as control and substituted with 10% and 20% of pumpkin(peel and pulp).

Methods

Determination of gross chemical composition

Moisture, protein, fat, crude fiber and ash contents were determined according to the methods described by *A.O.A.C.*, *(2010)* . The caloric value was calculated according to the method of *Seleet,(2010).*

Caloric value =(protein×4)+(fat×9)+(total carbohydrate×4).

Determination of minerals content of biscuits

The total content of elements was carried out using a HNO_3) / nitric acids ($HCIO_4$/mixture of perchloric acid according to the elements, Calcium, Iron, Zinc and Magnesium contents in the samples were determined using the ICP (ICAP6200) according to *Isaac and Johnson (2002).*

Determination of β – Carotene in biscuits

Five grams of sample was taken, crushed in 10-15 ml of acetone with the help of pestle and mortar and a few crystals of anhydrous sodium sulfate were added. The supernatant was decanted into a beaker. The process was repeated twice and

combined supernatant was transferred to separating funnel, then 10-15 ml of petroleum ether was added and mixed thoroughly. Two layers separated out on standing. The lower layer was discarded and the upper layer was collected in a 100 ml volumetric flask. The volume was made to 100 ml with petroleum ether and optical density was recorded at 452 nm using petroleum ether as blank *Srivastava and Kumar, (2002)*.The β-carotene was calculated using the following equations:

$$\beta\text{ -carotene (mg/ 100g)} = \frac{optical\ density\ of\ sample \times 13.9 \times 10^4 \times 100}{weight\ of\ sample \times 560 \times 1000}$$

Determination of vitamin E

About 1 g of sample was weighed into 100 mL flask, 10 mL of absolute alcohol and 20 mL of alcohol tetraoxosulphate VI acid were added. About 10 mL of the clear solution was pipetted into a test tube and heated in a water bath at 90EC for 3 min. This was allowed to cool. The absorbance was read in a spectrophotometer at 470 nm wavelength *Ighere et al.,(2019).*

Physical evaluation of biscuits

Biscuits were evaluated for height $(cm)^3$,width $(cm)^3$,spread ratio and spread factor.Three biscuits were used for the evaluations from each of the three studied biscuits and averages were recorded.The spread ratio and spread factor were calculated according to *Manohar and Rao ,(1997)* using the following equations:

$$\text{Spread ratio} = \frac{\text{width}}{\text{Height}}$$

$$\text{Spread factor} = \frac{\text{Spread ratio of sample}}{\text{spread ratio of control}} \times 100$$

Sensory evaluation of biscuits

The Biscuits products were evaluated for their cohesiveness,15 judges from the staff of Nutrition and Food Science department ,Faculty of Specific Education, Assiut University using color, texture, taste, odor, and overall acceptability were done in order to determine consumer acceptability. A numerical hedonic scale ranging from 1 to 10

(1 is very bad and 10 for excellent) was used for sensory evaluation *Larmond (1977)*. Ten experienced judges participated in the test.

Statistical Analysis of biscuits

Data were analyzed applying T- test using SPSS program version 16 and the data were analyzed with analysis of variance (ANOVA) procedures by using the *MSTAT- C(1983)* statical software package *Russell,(1983)*.Where the F-test showed significant differences among mean *Duncan ,(1995)* multiple range tests performed at the 0.05 level of probability to separate mean.

Resultes and discussion

Table (2) Statistical analysis of gross chemical composition and caloric values of wheat flour biscuits and fortified biscuits with 10%,20% pumpkin (peel and pulp) powder on (D.W)[a] and(W.W)[b] (g/100g)[*].

samples		Moisture	Ash	Protein		Crude fiber		Crude fat		Total Carbohydrates (K.Cal		Caloric Value (K.cal /100g)	
				W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W	W.W	D.W
Wheat biscuits 72% extraction (contro)		5.20 ^{E} ±0.3	1.10^{D} ±0.044	٨ .55^{E} ±0.6	9.02 ^{B}±0.95	0.20^{E} ±0.01	0.21^{C}± 0.01	13.90 ^{A} ±0.6	14.66^{A}±1.3	71.05 ^{A}±2.3	74.95 ^{A}±1.6	443.50 ^{A}±3.6	467.83 ^{A}±4.2
Pumpkin peel	10 %	5.30 ^{D} ±0.4	3.99^{A} ±0.11	٩ .70^{B} ±0.7	10.24^{A}±1.2	0.33^{D} ±0.02	0.35^{B}± 0.02	13.60 ^{B} ±0.8	14.36^{A}±0.95	67.06 ^{B}±1.65	70.81 ^{C}±1.8	429.62 ^{B}±4.5	453.66 ^{B}±3.5
	20 %	5.45 ^{C} ±0.1	4.20^{A} ±0.21	9.90 ^{A} ±0.5	10.47^{A}±1.3	0.41^{C} ±0.03	0.43^{B}± 0.03	13.20 ^{C} ±0.9	13.96^{A}±1.2	66.84 ^{C}±1.3	70.69 ^{C}±1.6	425.76 ^{C}±6.2	450.30 ^{C}±4.2
Pumpkin	10 %	٥ .55^{B} ±0.3	2.20^{C} ±0.12	9.00 ^{D} ±0.4	9.53 ^{B}±0.98	0.70^{B} ±0.02	1.42^{A}± 0.03	12.70 ^{E} ±0.8	13.45^{B}±1.1	69.85 ^{A}±2.4	73.95 ^{A}±2.3	429.70 ^{B}±3.4	454.95 ^{B}±3.7

	20 %	5.66 ^{A} ±0.2	3.00^{B} ±0.13	9.26 ^{C} ±0.40	9.82 ^{A}±0.88	0.81^{A} ±0.04	0.86^{A}± 0.03	12.90 ^{D} ±0.7	13.67^{B}±0.65	68.37 ^{B}±1.6	72.47 ^{B}±2.4	426.62 ^{C}±5.6	452.22 ^{C}±2.8
F.test		14.23 **	17.25 **	21.20**	7.65 *	10.12 **	14.11 **	21.25 **	7.21 *	15.66 **	16.95 **	19.85 **	16.65 **

*** Mean of three replicates ,**
*** significant($p<0.05$) , ** Highly significant ($p \leq 0.01$) , N.S(The difference non significant)**
a:(D.W) =dry weight basis , b:(W.W)= Wet weight basis
The data of gross chemical composition of biscuits for 10%,20%pumpkin (peel and pulp) are presented in Table(2). The data revealed that there was a significant difference in moisture content that ranged from 5.20% to 5.66% .while, protein content ranged from 8.55% to 9.90%on wet weight basis and 9.02% to 10.47% on a dry weight basis ,likewise ,the highest protein content was recorded for biscuits fortified with 20%pumpkin peel powder. Ash content were 3.99% ,4.20 %,2.20% and 3.00% in biscuits fortified with 10% and 20%(peel and pulp) pumpkin .while, the crude fiber was significantly high(0.81%) in 20% biscuits of pumpkin pulp on wet weight basis and (0.86%) on dry weight basis
However,biscuits fortified with 10% pumpkin pulp was recorded the lowest percentage of crude fat (12.70%) as compared to wheat flour biscuits (13.90%) on a wet weight basis. On the other hand wheat flour biscuits recorded a high value in total carbohydrates. and caloric value(71.05% and 443.50 k.cal /100 g on wet weight basis ;respectively.These results were in agreement with *Ramadan et al ., (2010); Nguyan and Nguyen (2018) & shamaail and saher (2020)* ,They reported that the biscuit of pumpkin was high in protein ,ash, fiber and the lowest in moisture and carbohydrate that due to nutritional value of pumpkin powder.

Table (3); Statistical analysis of minerals content of wheat flour biscuits and fortified biscuits with (10%,20%) pumpkin(peel and pulp) powder (mg/100g)*.

Samples %	Types of biscuits					F-test
	Wheat biscuits 72% extraction (control)	Pumpkin peel		Pumpkin pulp		
		10%	20%	10%	20%	
Ca	82.01^{D} ±2.16	102.07^{B} ±3.72	285.33^{A} ±5.32	91.09^{c} ±1.63	100.05^{B} ±1.42	27.62**
Fe	$.00^{E}$١٥ ±0.82	$.20^{B}$٣٩ ±1.2	3^{A}٥.٦٤ ±2.4	3^{D}٢.٢٥ ±1.6	33.36^{C} ±2.3	40.55**
Zn	5.14^{E} ±0.6	8.53^{D} ±0.8	12.79^{C} ±1.1	14.22^{B} ±1.4	16.44^{A} ±0.9	9.88**
Mg	$.40^{D}$٢٦٥ ±2.4	٥٥٥ $.70^{B}$ ±9.1	0^{A}٣.٧٩٩ ±8.6	$.30^{C}$٤٠٥ ±13.6	$.10^{B}$٥٣٥ ±11.5	21.6**

***Mean of three replicates , * significant($p<0.05$) , ** Highly significant ($p \leq 0.01$)**

The minerals content of biscuits made from wheat flour 72% extraction fortified with 10%,20% pumpkin (peel and pulp) powder are shown in Table (3).The data indicated that there was a significant varietal cellect on Ca,Fe,Zn and Mg ,The highest increments were observed in 20% biscuit of peel pumpkin , the contents of Ca,Fe,Zn,Mg were recorded (285,33, 64.53, 12,79 and 799.30 mg/kg) in 20%peel biscuits pumpkin and the lowest values in the biscuits with wheat flour were recorded (82.01, 15.00 ,5.14 and 265.4 mg/kg) These results agree with *Kulkarni and Joshi (2013) & Malkanthi and Umadevi (2018)* reported that the nutrients composition of 5%

pumpkin mixture incorporated biscuits was significantly increased in calcium and iron compared to control

Table (4) :Statistical analysis of □-Carotene and vitamin E of wheat flour and fortified biscuits with 10%,20% pumpkin (peel and pulp) powder mg/100g.

Samples		**□-Carotene** mg/100 g	**Vitamin E** mg/100 g
Wheat biscuits72 % extraction (control)		0.34^{D} ±0.04	0.04^{D} ±0.001
Pumpkin peel	10 %	0.53^{C} ±0.05	0.25^{C} ±0.01
	20 %	0.84^{B} ±0.1	0.29^{C} ±0.02
Pumpkin Pulp	10 %	0.95^{B} ±0.07	1.16^{B} ±0.1
	20 %	1.20^{A} ±0.2	2.13^{A} ±0.3
F-test		**13.25****	**15.33****

*** significant(p<0.05) , ** Highly significant (p ≤ 0.01)**

The □-Carotene content in pumpkin under study is presented in Table (4) The results showed that pumpkin pulp powder contains significantly (P<0.01) higher in □-carotene than pumpkin peel powder .The highest □-Carotene was in biscuits fortified with 20% pulp pumpkin which recorded 1,20 mg/100g, while ,the lowest □-carotein was in wheat flour biscuit (control) that was recorded 0.34 mg/100g .These results agree with,*Ramadan et al ., (2010) ;Malkanthi and Umadevi*

(2018) & Samaa and Salim(2020) **showed that nutrients composition of pumpkin mixture incorporated wheat biscuits was significantly increased in □-Carotene compared with control whereas pumpkin mixture blended biscuits was 0.95 mg/100g .**

Vitamin E contents of pumpkin (peel and pulp) are shown in Table (4). It was noticed that pumpkin (peel and pulp) was significantly (p <0.05) had the highest content of vitamin E with values 1.16 and 2.13 mg/100g ; respectively. However, the lowest content of vitamin E within wheat flour biscuit (0.04mg/100). The results agree with *Saliha et al.,(2014)*.

Table (5) : Statistical analysis of Physical characteristics of wheat flour biscuits and fortified biscuits with 10%, 20% of pumpkin (peel and pulp) powder.

Physical characteristics / Samples		Width (Cm)	Height (Cm)	Spread ratio (C)	Spread factor%(d)
wheat biscuits 72% extraction (control)		5.30^{D} ±0.4	1.20^{A} ±0.02	4.42^{C} ±0.2	100.0^{B} ±2.1
Pumpkin peel	10%	5.80^{B} ±0.3	1.15^{B} ±0.04	5.04^{B} ±0.1	114.0^{A} ±3.2
	20%	5.60^{C} ±0.5	1.10^{C} ±0.03	5.09^{B} ±0.3	115.2^{A} ±4.1
Pumpkin Pulp	10%	5.80^{B} ±0.2	1.12^{C} ±0.01	5.18^{A} ±0.2	117.2^{A} ±5.3
	20%	6.00^{A} ±0.1	1.16^{B} ±0.03	5.17^{A} ±0.4	117.0^{A} ±4.7
F-test		10.91**	13.20**	7.22*	6.20*

C=spread ratio = $\frac{Width}{Height}$ **d=**$\frac{Spread\ ratio\ of\ sample}{Spread\ ratio\ of\ control} \times 100$

Data tabulated in Table (5) show the physical characteristics of wheat flour biscuits and fortified biscuits with 10%, 20% Pumpkin (peel and pulp) . The data recorded a gradual increment of spread ratio of both10% and 20% fortified wheat biscuits with peel and pulp powder. Considering

the spread factor of biscuits 100%wheat flour(72% extraction) Results given in Table(5) indicated that it increased from 114,0 to 117.20 for 10%,20% fortified biscuits with peel and differences in baking characteristics of developed biscuits could be due to the differences in the quality and quantity of protein in the dough and also may be related to the gas retention ability of the dough during the baking process.

Table (6) : Statistical analysis of Sensory characteristics of wheat flour biscuit and fortified biscuit with 10%, 20% pumpkin (peel and pulp) powder.

Sensory characteristics		Color	Texture	Taste	Oder	Over all Acceptability
Samples		(10)	(10)	(10)	(10)	(10)
Wheat biscuits 72% extraction (control)		.10^{E}±0.5٨	8.90^{C}±0.4	.10^{E}±0.7٨	9.75^{A}±0.3	9.05^{C}±0.02
Pumpkin Peel	10 %	.60^{C}±0.8٨	8.55^{D}±0.3	8.45^{D}±0.8	8.80^{C}±0.4	8.70^{D}±0.3
	20 %	.10^{B}±0.4٩	.05^{E}±0.2٨	.--٨ 80^{C}±0.9	٨ .55^{D}±0.5	8.30^{E}±0.2
Pumpkin Pulp	10 %	.45^{D}±0.3٨	9.05^{B}±0.7	9.05^{B}±0.6	٨ .35^{E}±0.3	9.55^{B}±0.3
	20 %	9.60^{A}±0.6	.50^{A}±0.7 ٩	9.50^{A}±0.6	٩ .10^{B}±0.2	9.85^{A}±0.4
F-test		12.21**	15.36**	17.31**	13.51**	14.11**

*** significant($p<0.05$) , ** Highly significant ($p \leq 0.01$).**

Results of sensory characteristics in terms of colors ,texture ,taste, oder and overall acceptability of biscuits fortified with (10%,20%) pumpkin (peel and pulp) powder are between biscuits fortified with 10%.20% pumpkin (peel and pulp) powder. The texture ,taste ,oder of biscuits fortified 20% pumpkin peel powder were recorded,the highest values (9.50, 9,50 and 9.10);respectively. These results agree with *Shamaail and Saher(2020)* found that the mean values of overall acceptability of biscuits showed that biscuits with replacement with ratio with 3% of pulp and peel flour were the highest ,Color in biscuits due to the presence of carotene and chlorophyll pigments in pumpkin, The strong oder may be due to the strong aroma and flavor of pumpkin tested in high concentrations.The soft texture of biscuits are due to the good ability of pulp flour to hold water better than peel flour this analysis is supported by *See et al.,(2007).*

Figure (1):Control biscuit (72% extraction)

Figure(2):Biscuit fortified with 10% pumpkin peel powder .

Figure(3):Biscuit fortified with 20% pumpkin peel powder.

Figure(4):Biscuit fortified with 10% pumpkin pulp powder.

Figure(5):Biscuit fortified with20% pumpkin pulp powder

Conclusion

Results revealed that pumpkin mixture blended biscuits had improved nutrients composition ,textural and sensory properties .Therefore, it can be supplemented successfully into food products to enhance the nutrient content and this will be benefited in a wide variety of food applications such as functional and therapeutic food products.

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الإستفادة من مسحوق القرع العسلي لتحسين القيمة الغذائية والخصائص الفيزيائية للبسكويت

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٢بكالوريس التربية النوعية ، جامعة، جامعة أسيوط (٢٠١٧).

الملخص العربي

يحتوي القرع العسلي على قيمة غذائية عالية من البروتينات والألياف والكربوهيدرات ومضادات الأكسدة. لذلك تهدف هذه الدراسة لتقدير التركيب الكيميائي والمعدني والبيتا كاروتين،وفيتامين هـ ، بالإضافة إلي تقدير الخصائص الفيزيائية والحسية لبسكويت القمح والبسكويت المدعم بنسب (١٠%، ٢٠%) من قشور ولبابة القرع العسلي. أظهرت النتائج أن التركيب الكيميائي الإجمالي للبسكويت المدعم بمسحوق ٢٠٪ من قشر القرع العسلي به نسبة عالية من البروتين 10.47٪ بينما سجل بسكويت دقيق القمح (العينة الضابطة) أقل قيمة في البروتين 9.02 % ، والألياف الخام ٠,٢١% كما سجل البسكويت المضاف له ١٠% من لبابة القرع العسلي أقل قيمة للدهون حيث سجلت 13.45 % علي الوزن الجاف. كما أشارت النتائج إلى وجود فرق معنوي أكبر في المحتوى المعدني بين البسكويت المدعم بقشور ولبابة القرع العسلي . بالإضافة إلى ذلك ،سجل البسكويت الذي يحتوي على ٢٠٪ قشور أعلى قيمة في الكالسيوم ، الحديد، الماغنسيوم(٧٩٩,٣) وأعلى قيمة للبيتا كاروتين كان في البسكويت المدعم بـ ٢٠٪ من لبابة القرع العسلي حيث سجل ١،٢٠ مجم / ١٠٠ جم ، بينما سجل البيتا كاروتين أقل قيمة في بسكويت القمح الذي سجل (٠,٣٤ مجم / ١٠٠ جرام). كما أظهرت الخصائص الفيزيائية والحسية فروقا ذات دلالة احصائية عالية في البسكويت المدعم بنسبة 20% من لبابة مسحوق القرع العسلي ، لذلك يوصى باستخدام القرع العسلي في مختلف فورميولات الغذاء لتحسين القيمة الغذائية

الكلمات المفتاحية: القرع العسلي ، التركيب الكيميائي ، المحتوي المعدني ، الفيتامينات ، البسكويت .

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