



Evaluation of nutrition value of crackers supplementary with basil seeds

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Abstract

This research was achieved to evaluate the basil seeds as determined antioxidant content and activity and also the identification of essential oil using GC-MS. Wheat flour was supplemented with basil seeds to produce crackers at 5.0, 10.0, 15.0 and 20.0% levels. Chemical composition was determined in raw materials and its formulae and also physical characteristics and sensory evaluation were studied in crackers at different levels.

The results showed that the essential oils of basil seeds identified and the major constituents as linalool, Methyl cinnamate, α -Pinene, Naphthalene, β -Pinene, Methyl chavicol, Limonene and α -Terpinene were 19.76, 15.85, 12.20, 11.0, 9.53, 6.24, 5.13 and 4.62%, respectively. Antioxidant content and activity were the highest in basil seeds may be due to the basil seeds had contained high amounts from essential oil. Moreover the chemical composition of the basil seeds noticed that the highest in protein, lipids, crude fibers, and ash content and wheat flour were the lowest in all parameters. Moreover, the formulae were increased gradually in all measurements when the basil seeds were increased.

The physical properties for crackers showed that the diameters, weights and spread ratio of different crackers were reduced and thickness was increased with increasing level of replacement with basil seeds. Crackers hardness were reduced than to control cracker this may be the basil seeds had contained rich amounts from oil which when increased in crackers hardness or breaking were decreased.

Results from the sensory evaluation of crackers observed that the score taste found that slightly or nearly decreased between control crackers and different crackers supplemented with basil seeds. A perfect aroma of basil crackers may be due to the presence of volatile oils with various chemical constituents. Texture scores showed gradually decreased between control crackers and different crackers up to 20% substitution levels.

From the obviously results it could be recommended that the basil seeds had contained a good source in the chemical constituents, antioxidant activity may be due to the highest amount from essential oil. Therefore, the supplemented wheat flour with basil seeds at 5.0, 10.0, 15.0 and 20.0% levels to give four different crackers showed that high quality from physical properties and sensory evaluation of crackers up to 20% addition from basil seeds.

Keywords: Basil seeds, *Ocimum basilicum*, Gas chromatography and mass spectrometry

Introduction

Attention in medicinal plants has begun to grow may be caused by the highest quality of being efficient of new plant-derived drugs and the growing concern in natural products. For the reason that the worries about the side effects of traditional medicine, as well as utilize of natural products as an alternative to traditional therapy in the recovery and therapy of different diseases has been on the elevate in the last few decades. The use of plants as medicines dates from the earliest years of man's development (Dattner *et al.*, 2003 and Fong, 2002) [10]. Medicinal herbs provide curative alternatives, safer option, or in some situation, as the successful therapy (Salem, 2005) [31].

Sweet basil (*Ocimum basilicum* L.), is the oldest herbs belonging to the Lamiaceae family is commercially and widely cultivated for volatile oil production in many continents about the global (Baby *et al.*, 2007) [7].

At a recent time, Sweet basil (*Ocimum basilicum*) was observed to status the highest between species and herbal crops could be contained rich amounts from the natural antioxidant as phenolic compounds, volatile oils that are connected with lowering risks of cancer and aging diseases (Taie *et al.*, 2010) [36].

Basil (*Ocimum basilicum*) had contained volatile oils which also answerable for its particular odor. The installation of the essential oils is affected by its growing environment (Sulianti, 2008) [35]. As well as to sineol and eugenol as essential oils, basil had contained the highest amounts from flavonoids compounds, saponins, and tannins content. Sweet basil is recognized to be having the power to inhibit the growth of infective bacteria (Harmely *et al.*, 2014). In the field of health, basil has observed influence as a natural desire stimulant, laxative, as a perfume, and breast milk stimulator (Sulianti, 2008) [35].

The greatest economic value of basil oil may be caused to the presence of essential oil, had contained the major compounds as eugeno, chavicol, and their derivatives or terpenoids as monoterpene alcohol linalool, methyl cinnamate, and limonene. The antioxidant activity of phenolic acids and flavonoids compounds may be caused to their redox characteristics, which can play a significant role in scavenging the free radicals, quenching singlet and triplet oxygen, or cause to decay peroxides Asami *et al.*, 2003) [6]. Snack foods are common and very use and derive benefits throughout the globe. They are useful and light and often eaten among regular meals (Lusas, 2001) [23]. Novel functional snack foods, especially bakery product, with

potential health benefits are in are high demand by consumers. Numerous studies have assessed the production of bakery products like crackers (Ahmed and Abozed, 2015) [4].

Baked products are economical to run and have built in marketability. The texture of a cracker is often described as a presence crunchy or crispy, which depending on the ingredients of crackers. Tunick *et al.* (2013) [38] observed that consumers characterize the crackers as possess a crisp texture. Seeds of the herb plant basil (*Ocimum basilicum* L.) are a source of dietary fiber that is used in desserts and beverages in some parts of Asia. The mucilage extracted from basil seeds contains polysaccharide, mainly composed of glucomannan and xylan. It has high non-gelling and shear-thinning properties and can be used abundantly in foods (Song *et al.*, 2017) [34].

The aim of this research was to evaluate the basil seeds and it was to supplement to produce crackers at different levels 5, 10, 15, 20%, respectively. Physical characteristics, hardness and sensory evaluation were determined in crackers product samples.

2. Materials and Methods

Materials

Wheat flour (72% ext.) and basil (*Ocimum basilicum*) seeds were obtained from local market in Saudi Arabia. The other stating materials used in preparation of crackers i.e., salt, sugar, butter, fresh milk, starch, sodium bicarbonate and baker's yeast were purchased from a local market.

Methods

Distillation of essential oil

The dried basil (*Ocimum basilicum*) seeds were ground prior to the operation and then 100 g of ground basil seeds were submitted to water distillation for 4 hrs using a Clevenger apparatus according to European Pharmacopoeia (Council of Europe, 1997). The distilled essential oils were dried over anhydrous sodium sulfate, filtered and the obtained essential oil was stored in a sealed glass vial at 4-5°C prior to analysis of GC/MS.

Gas chromatography and mass spectrometry (GC/MS)

Gas chromatography and mass spectrometry analyses were performed on Perkin-Elmer mass spectrometer using BPX5 column (30 m×0.25 mm×0.25µm phase thickness). An electron ionization system with ionization energy of 70 eV was used for GC/MS detection. The carrier gas was helium with a flow rate of 1.3 ml/min. Injector and MS transfer line temperatures were set at 230 °C and 250 °C, respectively. The oven temperature was the same as with GC analysis. Diluted samples (1/10 in acetone, v/v) of 1.0µL were injected in the split/split less (5:1 split) mode according to Adams (2007) [2].

Determination of total phenolic and flavonoids content

The total phenol content of the extracts was determined using Folin–Ciocalteu reagent according to Xu and Chang (2007) [42]. The total phenolic content was calculated using milligrams gallic acid equivalents per gram dry weight (GAE mg/g of dry weight).

The total flavonoids content will be determined by the method of Eghdami and Sadeghi (2010) [12]. The flavonoid content is expressed in terms of milligrams of quercetin equivalent per gram dry weight (mg QE /g of dry weight).

Determination of antioxidant activity

The free radical scavenging activity 1, 1-diphenyl-2-picrylhydrazyl (DPPH) scavenging activity of basil extract (nonvolatile) was measured by spectrophotometer at 517 nm as reported by Kim *et al.* (2005) [21].

Antioxidant activity was also determined by β-carotene method using spectrophotometer at 470 nm by following the method of Hinneburg *et al.* (2006) [19].

Chemical composition of raw materials and its formulae

Crude protein, crude fiber, crude fat and ash content were determined in raw materials and its formulae according to the method described in AOAC (2016) [5]. Total carbohydrates were calculated by difference.

Preparation of Crackers

For making crackers, according to Han *et al.* (2010) [17] the formulae for crackers are reported in Table (1). Pieces cut of dough were formed using the templates with an outer diameter of 5 mm. The crackers were baked at 170° C for 15 min at Patisserie Mazaq El-Maleka Factory in Taif Saudi Arabia, after baking; crackers were allowed to cool at room temperature for 1 hr before evaluation.

Table 1: Ingredients for crackers formula

Ingredients	Control	Cracker formulae supplemented with basil seeds			
		5%	10%	15%	20%
Wheat flour	100	95.0	90.0	85.0	80.0
Basal seeds	-----	5.0	10.0	15.0	20.0
Butter	10.0	10.0	10.0	10.0	10.0
Salt	3.0	3.0	3.0	3.0	3.0
Sugar	3.0	3.0	3.0	3.0	3.0
Yeast	3.0	3.0	3.0	3.0	3.0
Fresh milk	50.0	50.0	50.0	50.0	50.0
Starch	4.0	4.0	4.0	4.0	4.0
Sodium bicarbonate	0.2	0.2	0.2	0.2	0.2

Physical characteristics of crackers

Crackers were evaluated for weight (g), thickness (mm), diameter (mm), density (g/cm³) and spread ratio as described by Gaines (1991) [13]. Six crackers edge-to-edges were used for the evaluation and the average was noted. Diameter and thickness were measured using a Vernier Caliper. Spread ratio was calculated from the ratio of diameter to thickness. Density was calculated from the ratio of weight to volume.

Crackers hardness

Crackers hardness was determined using a Texture Profile Analyzer (TPA) according to AACC (2002) [1]. Crackers hardness was determined using Texture Analyzer machine (Brookfield Engineering Lab. Inc., Middleboro, MA 02346-1031, USA). A 25-mm diameter cylindrical probe was used in a TPA at 2 mm/s speed. Hardness was calculated from TPA graphic in Newton (N).

Sensory evaluation

Crackers samples were organoleptic evaluated for its sensory characteristics. Crackers sample was served on white, odorless and disposable plates and water was provided for rinsing between samples for ten panelists. Samples were scored for color, taste, flavor, texture, appearance and overall acceptability. Control crackers were

used to compare with tested samples for sensory test. The evaluation was carried out according to the method of Wanyo *et al.* (2009) [40].

Statistical analysis

The obtained data were exposed to analysis of variance. Duncan's multiple range tests at ($P \leq 0.05$) level was used to compare between means. The analysis was carried out using the PRO ANOVA procedure of Statistical Analysis System (SAS, 2008) [30].

3. Results and Discussion

Identification and quantification of the oil components from basil seeds:

Table (2) shows the constituents of the essential oils of basil seeds. Exactly 16 compounds, mostly aromatic, were identified in the oil of basil seeds extract. The major constituents were linalool, Methyl cinnamate, α - Pinene, Naphthalene, β -Pinene, Methyl chavicol, Limonene and α -Terpinene were 19.76, 15.85, 12.20, 11.0, 9.53, 6.24, 5.13 and 4.62%, respectively. Other important compounds as β -myrcene, Caryophyllene, Sabinene, Germacrene, Terpinen-4-ol, Spathulenol, β -Farnesene and B-Ocimene were 3.25, 3.15, 2.40, 2.11, 2.00, 1.59, 0.74 and 0.4%, respectively. There is variation in the ingredients of the basil oils, and various chemotypes have been established from different phytochemical research (Sajjadi, 2006) [29]. Meanwhile, the oils of various chemotypes of *O. basilicum* are found as

main ingredients like methyl chavicol, linalool, methyl cinnamate, methyl eugenol, eugenol, and geraniol (Sajjadi, 2006) [29].

Siddique *et al.*, (2016) [33] suggested that the chemical composition of essential oil was depending largely on its color. Moreover, the alteration of the essential oil color as the outcome of their constituents is suggested could with be caused to thermal degradation, oxidation, isomerisation, dehydrogenation and polymerization (Taraj *et al.*, 2013 and Hadaruga *et al.*, 2014) [37, 16].

Total phenolic and flavonoids content and antioxidant activity in basil seeds

Antioxidant content and activity were determined in basil seeds and the results were tabulated in Table (3). The results found that the basal seeds rich amounts from total phenolic acid content and flavonoids compounds were 47.76 mg / g gallic acid equivalent and 10.53 mg / g quercetin equivalent. These results are confirmed by Wojdylo *et al.* (2007) [41] who reported that the basil seeds had the greatest total phenolic content that amounted to 45.67 \pm 0.77 mg/g dry weight. A considerable connection among the antioxidant activity and total phenolic content in basil seeds showed that the phenolic compounds were the dominant antioxidant compounds. Herbs are a superior source of natural antioxidants, and some of them even perform better than the synthetic antioxidants and it was safer from the health point of view (Sarfraz *et al.*, 2011) [32].

Table 2: Chemical composition of the basil seeds essential oil analyzed by gas chromatography-mass spectrometry

Major compounds	Oil composition (%)	Other compounds	(%) Oil composition
linalool	19.76	β - myrcene	3.28
Methyl cinnamate	15.85	Caryophyllene	3.15
α - Pinene	12.20	Sabinene	2.40
Naphthalene	11.00	Germacrene	2.11
β -Pinene	9.53	Terpinen-4-ol	2.00
Methyl chavicol	6.24	Spathulenol	1.59
Limonene	5.13	β -Farnesene	0.74
α -Terpinene	4.62	B-Ocimene	0.4

Concerning that the antioxidant activity, the results observed that the basil seeds had contained the highest to scavenging free radical activity. In the case of DPPH, methanol extract of basil seeds found that the maximum and the minimum free radical scavenging activity were 84.59 and 57.35%. In the case of β -carotene, the maximum antioxidant activity (94.86%) was found of basil seed (Sarfraz *et al.*, 2011) [32].

The natural antioxidant as phenolic acids and aromatic compounds extracted from volatile oil they're extracted from basil seeds had caused antimicrobial and antitumor activities (Gutierrez *et al.*, 2008) [15]. Therefore, phenolic content evaluation of basil seeds is required to be done to detect the connection of basil seed with the health-elevating role, as antioxidant capacity of phenolic compounds prevent the cell from free radicals which give rise to the damage (Zhang *et al.*, 2013) [43].

Table 3: Total antioxidant and activity in basil seeds

Total antioxidant and activity	Amounts in basil seeds
Total phenolic (gallic acid equivalent mg / g)	47.76 \pm 3.54
Total flavonoids (quercetin equivalent mg/g)	10.53 \pm 2.13
Antioxidant activity DPPH %	64.82 \pm 3.59
Antioxidant activity β -carotene %	88.21 \pm 4.27

Values are expressed as mean \pm SE of 3 replicates

Chemical compositions of raw materials and its different formulae

Chemical constituents of wheat flour 72% extraction and basil seeds and its different formulae were determined and the results are showed in Table (4). From the results, it could be noticed that the basil seeds the highest total protein, lipids, ash content, and crude fibers were 19.54, 11.68, 8.11 and 6.31 g/100g dry weight whilst, wheat flour the lowest the same parameters were 11.43, 2.50, 0.90 and 0.50 g/100g dry weight, respectively. Total carbohydrates the highest in wheat flour and the lowest in basil seeds were 84.67 and 54.36% the other formulae crackers.

Concerning of formulae, the results observed that the total protein, lipids, ash content, and crude fibers were increased from the formula which had contained 5% basil seeds from 11.75, 2.90, 1.30 and 0.80% to 13.63, 3.90, 2.70 and 1.70% in formula which contained 20% basil seeds, respectively. These increase in results, it could maybe the basil seeds have contain high amounts from these measurements. Moreover, the total carbohydrates were decreased from the formula 5% (83.25%) to 78.07% in formula 20% may be able to be the wheat flour have contained high amounts

from total carbohydrates. In particular, dietary fibers, which are carbohydrate-based materials, can act as a thickener and

stabilizer to provide an effective fat substitute in foods (Brennan and Tudorica, 2008) [8].

Table 4: Chemical compositions of raw materials and its different formulae

Chemical compositions	Wheat flour 72%	Basil seeds	Different formulae at levels			
			5%	10%	15%	20%
Protein	11.43±2.25	19.54±2.49	11.75±2.14	12.51±2.38	13.11±2.44	13.63±1.97
Lipids	2.50±0.94	11.68±2.49	2.90±0.81	3.12±0.57	3.60±0.38	3.90±0.71
Fiber	0.90±0.04	8.11±2.48	1.30±0.92	1.70±0.73	2.10±0.94	2.70±0.83
Ask	0.50±0.02	6.31±1.23	0.80±0.06	1.10±0.75	1.40±0.27	1.70±0.38
Total carbohydrates	84.67±7.36	54.36±3.57	83.25±5.29	81.57±6.38	79.79±4.12	78.07±5.04

Values are expressed as mean ± SE of 3 replicates

Physical characteristics of crackers supplemented with basil seeds

Physical analysis of crackers is very important for both consumers and manufacturers. The spread of the crackers should be according to specifications. Too much elasticity (gluten) in the dough will spring back to give thicker crackers with smaller diameter; while too little elasticity may cause the dough to flow after molding, resulting in thin crackers with larger diameter (Mian *et al.*, 2009) [24].

Physical characteristics were determined of different crackers supplemented with basil seeds at level 5, 10, 15 and 20% and the results are recorded in Table (5). The results showed that the diameters, weights and spread ratio of different crackers were reduced and thickness was increased with increasing level of replacement with basil seeds. These results were similar to those reported by Agrahar-Murugkar *et al.*, (2018) [3] they showed a lowering

in spread factor and weight of cookies by elevating the supplementing levels of flour with basil seeds.

Crackers hardness is defined as the maximum force required breaking or fracturing the product. The same table observed that the addition of different levels of basil seeds reduced crackers hardness compared to control cracker this may be the basil seeds had contained rich amounts from oil which when increased in crackers hardness or breaking were decreased. Li *et al.*, (2014) [22] regard as being caused by finding the cracker structure, which was different and had an internal structure with a decreased level of puffing, which leads to a crisper cracker than control crackers.

Hardness is concerning to the force which needs by the teeth to crush food (Paula and Silva, 2014) [26]. Hardness on crackers can be estimated by a sensory test utilizing the term of crispness. The values of crispness are the opposite of hardness, for this reason, low hardness value gives high crispness (Nurul *et al.*, 2009) [25].

Table 5: Physical characteristics of different crackers

Types of additions	Weight (W/g)	Diameter (D/cm ³)	Thickness (T/cm ³)	Spread Ratio (D/T)	Specific Volume (cm ³ /g)	Density (g/cm ³)	Hardness (N)
Control Cracker	4.20±0.05a	5.60±1.24a	0.30±0.04b	18.66±1.73a	1.33±0.08a	0.73±0.03a	26.00±1.85a
5%	4.08±0.06a	5.50±1.85a	0.33±0.08ab	16.67±1.65b	1.35±0.03a	0.71 ± 0.02a	24.36±1.24a
10%	3.95± 0.01ab	5.33±0.65ab	0.36±0.05ab	14.81±1.13bc	1.35±0.06a	0.61 ±0.06b	20.35 ±1.03b
15%	3.82± 0.02ab	5.12±0.13ab	0.39±0.05ab	13.13±1.07bc	1.34±0.18a	0.59 ±0.07b	18.03±1.65c
20%	3.75±0.07b	5.00±1.65b	0.41±0.06a	12.20±1.98c	133±0.07a	0.54±0.03c	16.11±0.98d

Values are mean and SD (n = 3); where: Mean values in the same row with the same letter are slightly significantly different at 0.05 levels

Sensory evaluation of different crackers

Table (6) and Photo (1) pointed out the sensory evaluation of different crackers and the results found that the scores for odor and flavor showed slightly increased between control crackers made from wheat flour and its crackers supplemented with 5, 10, 15 and 20% basal seeds may be due to basil seeds had contained high amounts from volatile oil. In addition, essential oil, and any other plant-based natural components in basil seeds are gives especially trust of legal, regulatory, and also consumer preference as the outcome of a shared opinion on food safety (Wandersleben *et al.*, 2018 [39]). (Modern uses for their volatile oils from basil seeds are not only for medicinal industries but also for food industries (Jordán *et al.*, 2017) [20].

The results from score taste found that slightly or nearly decreased between control crackers (19.45) and different crackers 19.0, 18.55, 18.0 and 17.50 supplemented with basil seeds with 5, 10, 15 and 20%. A perfect aroma in crackers made from basil seeds may be due to the presence of volatile oils with other plant ingredients. As well as, basil seeds had contained natural antioxidant especially phenolic compounds (Dumbrava *et al.*, 2012) [11]. The highest

amounts presence of phenolic compounds in basil seeds gives the best taste (Rudnitskaya *et al.*, 2010) [28].

Texture is extremely important to the consumer. The indicator of food quality is with using the texture by the consumer (Mian *et al.*, 2009) [24]. Texture scores showed gradually decreased between control crackers and different crackers up to 20% substitution levels. The decline in texture scores could be due to the decrease in gluten content with increased basil seeds there by reducing the crispiness of the crackers. Moreover, crackers have often been one of the greatest common and attractive food products could be caused to their superior nutritional, sensorial and textural properties, ready to eat suitability in addition cost competitiveness (Pratima and Yadava, 2000) [27].

The overall acceptability scores showed no significant difference between control treatment and sesame paste crackers up to 15% substitution but a decrease in values was seen with 20% substitution levels. Sensory properties of crackers of 15% basil seed were significantly more acceptable than all the others including control treatment. This could be due to the enhanced flavor (nutty aroma) imparted by the sesame paste (Gernah and Anyam, 2014) [14].

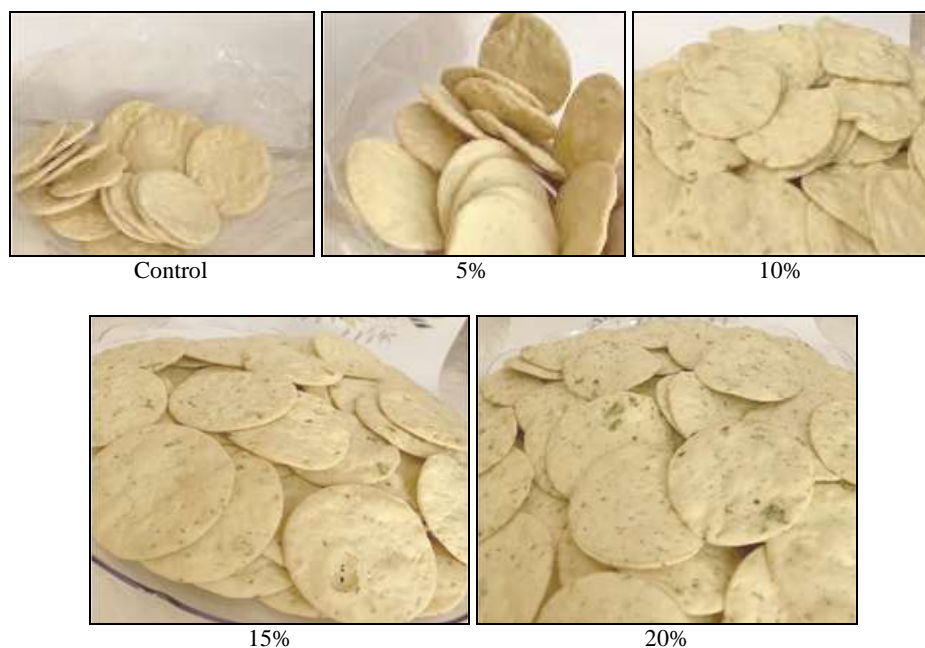


Photo 1: Showed that the crackers supplemented with basil seeds at different ratio

Table 6: Sensory evaluation of different crackers

Types of additions	Taste 20	Odor 20	Texture 20	Flavor 20	General Appearance 20	Overall acceptability 100
Control Cracker	19.45 ^a ±0.56	18.50 ^b ±0.13	18.63 ^a ±0.66	18.60 ^b ±0.55	18.80 ^a ±0.99	93.98
5%	19.00 ^a ±1.06	18.55 ^{ab} ±0.76	18.21 ^{ab} ±0.25	18.65 ^{ab} ±0.72	18.60 ^{ab} ±0.12	93.01
10%	18.55 ^{ab} ±0.21	18.62 ^{ab} ±0.35	17.85 ^{ab} ±0.35	18.70 ^{ab} ±0.87	18.86 ^{ab} ±0.43	92.40
15%	18.00 ^b ±1.06	18.80 ^{ab} ±0.65	17.45 ^b ±0.77	18.75 ^{ab} ±0.12	18.50 ^{ab} ±0.63	90.50
20%	17.50 ^c ±0.76	19.00 ^a ±0.79	16.35 ^c ±0.93	18.82 ^a ±0.93	18.07 ^b ±0.63	87.34

Values are mean and SD (n = 3); where: Mean values in the same row with the same letter are slightly significantly different at 0.05 levels

Conclusion

In the end, it could be concluded that the basil seeds had contained high amounts of chemical constantans, phytochemical and essential oil. Supplementation of wheat flour with basil seeds at 5.0, 10.0, 15.0 and 20.0% levels to give four different crackers was high in the parameters and sensory evaluation till 20% addition.

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