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Effects Of Storage Conditions On The Quality Of Aniseed

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Özet

Depolama Koşullarının Anason Tohumlarının Kalitesine Etkileri

Geleneksel olarak kurutulmuş anason tohumları Tekel-İZMİR deposunda jüt çuvallar (50-70 kg) halinde üst üste istiflenmiş ve üst, alt ve kapı yanı çuvallarından örnekler alınmıştır. İkinci olarak 3'er kg'lık küçük jüt torbalarda cam dolaplarda (hava hareketsiz, hava dolaşımlı, havalandırmalı) ve PE torbalarda oda koşullarında saklanarak; üçüncü olarak % 3 oksijenli (azot veya karbondioksit veya 1/2 azot + 1/2 karbondioksit) ve havalı kavanozlarda oda ve soğuk depo koşullarında tutularak incelenmiştir. 0.44 su aktivitesinde denemeye alınan anason tohumlarında bir yıllık dönemde gözlenen gelişmeler sınırlı boyutta kalmıştır. Göze çarpan gelişmeler, Tekel deposu koşullarında gözlenmiştir. Burada istif üstü ve kapı yanı çuvallardaki tohumlarda su miktarı artmış, uçucu yağ miktarı ve uçucu yağdaki transanetol oranı düşmüştür. Tohumlar zamanla matlaşmış ve renk L değeri düşmüştür. Denemelerde özellikle nemli havanın tohumlarda bozulmalara neden olduğu belirlenmiştir. Sonuç olarak, anason tohumlarının bir yıl süreli depolanmasında dış hava ile temasının kontrol altında tutulması yeterli görülmektedir.

Anahtar kelimeler: Anason tohumu, depolama, kalite

Introduction

Anise (*Pimpinella anisum* L.) is an agricultural crop and its fruits contain valuable volatile oil. The fruits are used in medicine, food and alcoholic drink industries in dried form (1, 5). Anise has various types such as Italian, Spanish, German and Russian (5). Although dried fruits are used as a spice and it is called aniseed in traditionally.

Anise fruits contain about 9.5 % water per dried weight. Furthermore, the seeds include protein (17.6 %), oil (15.9 %) and a considerable amount of carbohydrates (8). Kaya, (1989) and Bayram (1992) have found that the composition includes water (7.5-11.4%), volatile oil (1.8-2.9%), anethole in volatile oil (96-97%), protein

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(21%) and starch (23.2%). Kaya, (1989) reported that acid composition of non-volatile oil found in Çeşme anise in a proportion of 32.6 %, consists of oleic acid 67.6 %, linoleic acid 24.6 % and palmitic acid 4.1 %. Akgül, (1993) has found 34.7 % non-volatile oil in Çeşme anise.

The amount of volatile oil in aniseed, an important ingredient for high quality, is 1.5-3 %. According to the anise standard, the amount of volatile oil in first class anise should be at least 2 %. Although its mentioned for 2nd class seeds as min 1.5 %. The 90-98 % of volatile oil consists of trans anethole, and the rest aldehyde and methyl chavicole (3). Anise is stored under special conditions as a dried fatty and spicy fruit (3, 10). Similar to the dried fruits, aniseed is sensitive to moisture damage in the storage (10). High relative humidity increases water in aniseed, which accelerates the biochemical reactions, increases the activities of microorganisms, decreases the amount of volatile oil and leads to a bad smell (3). The aniseed loses its brightness after harvest and gets darker, since water increases substrate synthesis in non-enzymatic darkening. Free radicals and peroxides which are formed due to oxidation and lead to darkening of fats and formation of some toxic elements. Since lipolitic enzymes operate even at very low moisture levels the storage life of fatty products is limited. High temperature in storage lowers the quality of the product by accelerating oxidation and volatile oil diffusion (10). Oxygen is also effective in oxidation. The products, which contain a high amount of fat, are sensitive to oxygen. Especially under light conditions fats break up as a result of oxidation. Dry fruits generally decay microbiologically due to Aspergillus spp. If the seeds of these fruits contain water more than 13 %, the seeds become mouldy and if the water content is more than 20 % of the seed, bacteriological deteoration can occur (6). Dry products are stored in mass or in various packages. The necessity of preventing aroma loss in storing of aromatic products hinders storability and changes the storage conditions (3). Decays in volatile oils are generally attributed to oxidation, polymerisation and hydrolysis of esters (3). These phenomena are affected by heat, oxygen, moisture and light, where metals are the catalys. As a result, aldehydes are synthesized and aldehydes form organic acids by oxidation. Non-volatile oil change their colour, darken and smell badly (3; 11).

The aim of this work was to study the effect of various storage conditions on the quality of aniseed.

Materials and Methods

The experiment was conducted in 1998-1999. The aniseeds used in the study were the fruits of *Pimpinella anisum* L. growing at Çeşme-İZMİR.

The seed harvested and dried traditionally (2), were used in three separate experiments.

A. The samples were taken periodically (3, 6 and 12 months) from the seeds stored in jute sacks (50-70 kg), kept on top of each other (stacks made up of 7-8 sacks) in the State Monopoly (TEKEL) depot. Three samples were taken from the sacks, from the bottom, from the top and from near the entrance of storage were examined to find out the effects of ordinary storage conditions on the quality.

B. The seeds were put in three-kilogram-jute sacks and polyethylene bags, and jute sacks were kept in glass containers (air circulation; no air circulation; air conditioned) and PE bags in an ordinary room. This experiment was arranged in order to find out the effect of air circulation and air conditioning in the storing process. The flow of air circulation for a $0.12m^3$ container was $0.12m^3/h$. Three samples were taken during the storage period of 12 months.

C. The seeds were kept in 1 liter glass jars under four distinct air compositions (air, oxygen (3%) + nitrogen or cabondioxide or ½ nitrogen + ½ carbondioxide). The various gas concentrations were prepared with N_2 und CO_2 tubes using a manometer after vacuuming. These seeds were kept in room (15-20°C) and in cold storage conditions (0-4°C). The seeds of two replications were examined three times for quality changes.

At the beginning, the moisture content of the seeds (at 65°C and 103°C) (1), water activity (with hydrometer, ebro), reduced and total sugars (ROSS, 1959), starch (with anthrone) (7), volatile oil content, the percentage of trans anethole and anise aldehyde of volatile oil (by gas chromatography) (4) and colour properties with Minolta colorimeter 508 were measured. In the following examinations, moisture content, colour, volatile oil content and composition were examined. The statistical analyses were done according to a factorial arrangement and mean values were compared with LSD at the probability level 0.05 p value.

Results

At the beginning carbohydrate composition of aniseeds was as follows; reducing sugar 1.6 %, total sugar 11.7 % and starch 46.1%. Water activity of the seeds and moisture content was 5.2 % (at 65°C) and 9.5% (at 103°C).

A. Results of the studies in State Monopoly (TEKEL)'s depot (Table 1)

The moisture content of the samples taken from the depot show an increase during the storage period and it was 6.2 % at the end of the year. The highest moisture content was found in March as 7.2 %. The position

of the sacks affected the moisture content and the average amount was 6.0 % for the sack from the bottom, 6.6 % for the sack from the top and 6.3 % for the sack near the entrance.

During the storage period, the volatile oil content decreased down to 1.72 % at the end of the storage period. The volatile oil content in the sacks at the bottom and on the top of the stowage wasn't very different; however, volatile oil content in the seeds taken from the sack near the entrance was very low.

The percentage of trans anethole was affected slightly from environmental conditions during the storage period and it was about 97.8-98.1 % on average. The positions of the sacks in the depot didn't affect this amount. The percentage of the second important component, anise aldehyde, varied between 1.90-2.43 % on average. Trans anethole/anise aldehyde ratio almost didn't change and it was 48.4/1.

L value, the lightness, of the seeds decreased during the storage period (53.3→49.7). The value was high for the seeds at the bottom (53.3) and low for the seeds on the top. The value was the lowest for seeds near the entrance.

Table 1. Values of certain quality traits of the seeds in TEKEL depot.

	**September-98	December-98	March-99	August-99
Moisture %*	5.21	5.50 c	7.23a	6.19 b
Volatile oil %	2.12	2.15 a	2.14a	1.94b
Anethole %	98.1	97.8b	98.1a	97.8b
Aldehyde %	2.8	2.1	1.9	2.2
Anethole/Aldehyde	51	47b	53a	45b
Colour L	54	53a	50b	50b
A	3.3	1.8a	1.3b	1.8a
B	19	11	10	10
a/b	0.18	0.17a	0.13b	0.18a

	On the stowage	Under the stowage	Near the entrance
Moisture %*	6.63a	6.00c	6.29b
Volatile oil %	2.22a	2.29a	1.73b
Anethole %	97.8	98.0	97.9
Aldehyde %	2.2	2.0	2.0
Anethole/Aldehyde	46	49	50
Colour L	51b	53a	48c
A	2.1a	1.6b	1.1c
B	10b	11a	9c
a/b	0.21a	0.15b	0.12c

* dried at 65ºC, for 103ºC +4.3%
** values at the beginning

The a/b value, the red/yellow ratio, decreased slightly during the storage. However, the positions of the sacks affected the ratio and it was

0.21 for the seeds on the top, 0.14 for the seeds on the bottom and 0.12 for the seeds near the entrance, which was the lowest value.

The population of the fungi, yeast and bacteria in the samples taken from the depots of State Monopoly was low and it was about $10^3 gr^{-1}$.

B. Results pertaining to aniseeds kept in glass containers (boxes) (Table 2).

In this experiment, water content in the seeds increased during the storage process, similar to the depot. The amount of water content reached to its highest level in March-98. Where it is observed over awarage in the containers with air (6.4 %). In August the amount of water in the seeds was at the lowest level, which implies that the moisture in the seeds depends on the moisture content of the outside air.

The amount of volatile oil decreased at the end of the storage, but differences in storage conditions didn't have any effect on volatile oil content. The percentage of trans anethole in the volatile oil wasn't affected by storage conditions. The same was valid for anise aldehyde.

Table 2. Values of certain quality traits of the seeds in the glass containers.

	**September-98	March-99	August-99	
Moisture %*	5.21	6.75a	5.43b	
Volatile oil %	2.12	2.13a	1.87b	
Anethole %	98.1	97.8	98.0	
Aldehyde %	2.0	2.3	2.0	
Anethole/Aldehyde	51	46	50	
Colour L	54	51	51	
A	3.3	1.2b	1.5a	
B	19	11	10	
a/b	0.18	0.11b	0.15a	
	PE	No air circulation	Air circulation	Air conditioned
Moisture %*	5.99 b	5.95b	6.03b	6.38a
Volatile oil %	1.98	1.98	2.07	1.95
Anethole %	98.0	98.1	97.7	97.8
Aldehyde %	2.0	1.9	2.3	2.2
Anethole/Aldehyde	50	51	44	46
Colour L	50	51	51	50
A	1.3	1.4	1.4	1.2
B	10	11	11	10
a/b	0.12	0.13	0.14	0.13

* dried at 65ºC, for 103ºC +4.3%

** values at the beginning

C. Results of aniseeds kept in glass jars (Table 3).

The moisture content of the seeds kept in jars increased in March-99 and decreased in August. Nevertheless, the moisture contents were the same under room and cold storage conditions. The amount of moisture in

nitrogen and carbon dioxide applications was also the same, whereas it was lower for the seeds in jars with air.

The amount of volatile oil decreased during the storage period. However, room and cold storage conditions didn't affect the volatile oil content. The compositions of the gases changed the amount of volatile oil and it was the highest when the seeds were kept in carbon dioxide, the lowest in nitrogen + carbon dioxide. Similarly, the percentage of trans anethole decreased through time but room and cold storage conditions didn't have any effect on its ratio. In the same way, the percentage of anise aldehyde decreased through time, and the temperature didn't affect it during the storage process. The atmospheric composition in the jars was not effective on the two components.

Trans anethole/anise aldehyde ratio decreased in March-99 and increased in August-99. However, L values decreased through time (54-52-50). Furthermore, the values at room conditions were higher than those of cold storage. The gas composition in the jars didn't have any effect on the colour of the seeds. The values of red/yellow ratio (a/b) were low only in the jars that has air.

Table 3. Values certain quality traits of the seeds in jars.

	**September-98	March-99	August-99	Ordinary room	Cold storage
Moisture %*	5.21	6.02a	5.38b	5.70	5.70
Volatile oil %	2.12	2.07a	1.90b	1.98	1.99
Anethole %	98.1	98.0a	97.5b	97.8	97.7
Aldehyde %	2.0	2.5a	2.1b	2.3	2.3
Anethole/Aldehyde	51	39a	49b	45	43
Colour L	54	52a	50b	51a	51b
A	3.3	1.5a	1.3b	1.5a	1.36b
B	19	12a	10b	11	11
a/b	0.18	0.13a	0.13b	0.13	0.13

	N_2	$N_2 + CO_2$	CO_2	Air
Moisture %*	5.97 a	5.84 ab	5.96 a	5.03b
Volatile oil %	1.97ab	1.91b	2.08a	1.99ab
Anethole %	97.7	97.7	97.7	97.9
Aldehide %	2.3	2.3	2.3	2.2
Anethole/Aldehyde	44	44	43	47
Colour L	51	51	51	51
A	1.4a	1.5a	1.5a	1.2b
B	11	11	11	11
A/b	0.13a	0.14a	0.14a	0.11b

* dried at 65ºC, for 103ºC +4.3%

** values at the beginning

Discussion

The quality loss of the aniseeds stored under modified conditions for one year was not huge (Table 1).

The moisture content of the seed increased through time. This indicated that the seed, hygroscopic due to its sugar content, was affected by the moisture in the depot. In March, the amount of moisture in the atmosphere was the highest, the moisture content of the seeds in all three examinations were also the highest. Besides, the moisture content of the seeds was the lowest in August when the amount of moisture in the air was the lowest.

The high water content of the aniseeds in the sack, which was on the top, is the result of rising of hot air and transferring the moisture to the seeds. In the same way, the aniseeds in air-conditioned glass containers increased their water content due to moisture gains from outside air. The seeds kept in the glass containers with no air circulation, changed their water contents according to the balance between the internal atmosphere and the seed itself. Temperature didn't affect the amount of water directly in the jars or in room and cold storage. The water content didn't change.

The amount of volatile oil in the seeds decreased during storage; however, even in the TEKEL's depot the volatile oil decreased by 0.2 % in one year. But, the seeds kept near the entrance, were no more 1st class seeds, but 2nd class after March (2). This was the result of air movement around the entrance and the high speed of moisture diffusion. Moreover, the moisture in the atmosphere might have affected these seeds.

The percentage of trans anethole in volatile oil decreased slightly in the course of time. In well-dried aniseed the volatile oil content did not vary in respect to different atmospheric conditions or air movement.

The colour of the seeds lost their brightness in the duration of the storage and L value decreased steadily in all three experiments during the storage process. In TEKEL's depot, L value was the lowest in the seeds near the entrance, and it was the highest in the seeds at the bottom. Non-enzymatic darkening especially of the non volatile oils, was the main cause of the losses in L value. As the amount of moisture increases, the decrease in L value speeds up (11).

Aniseeds didn't undergo any significant microbiological activity during the storage, due to the low amount of water in the seeds (6).

Conclusion

Well-dried aniseeds were also resistant to decays since they include volatile oil. These seeds can be stored for one year in jute sacks in ordinary depot conditions without any decay. It will be quite useful to put the sacks over the pallets on the floor appropriately. Storage room must have two distinct doors for the entrance; the RH of the storage room

must be close to the water activity of the seeds. In order to keep the moisture content of the seeds at the same level it is necessary to avoid excessive air circulation and to ventilate the depot slightly. Since high amount of moisture was the main cause of the decay in aniseeds, the depot could be ventilated only if the outside temperature is lower than that of the depot and if the relative humidity is about 45-65 %.

Summary

Dried aniseeds were stored for 12 months in jute sacks (50-70kg), in a conventional TEKEL depot.-İZMİR. Samples were taken from sacks at the bottom and upper parts of the depot and near the store entrance. Secondly, seeds in jute sacks weighing 3kg, were put in three different glass containers (no air movement, with air circulation and fresh air intake) and in PE bags and stored in ordinary room condition. Thirdly, aniseeds in glass jars with 3% oxygen (plus nitrogen or carbondioxide or ½ nitrogen + ½ carbondioxide) and with air were stored in cold and ordinary room

The water activity (Aw) of aniseeds at the beginning was 0.44. The deteriorative development was little in the 12 months storage. Qualitative deterioration was observed in the large store of TEKEL. Moisture content was higher in sacks from upper part of the stacks and near the entrance than that of the bottom part of the stack depot but volatile oil content and trans anethole percentages in these were lower. Colours of aniseeds were darker and L-value was reduced during the storage period. In the other tests, there wasn't any qualitative difference between ordinary room and cold store, and between different air-conditioned glass jars, and in glass containers with different air movement and PE bags. There were deteriorative changes only in seeds that were in contact with air and with high RH.

In conclusion it is possible to store well-dried aniseeds for one year by controlling the contact of the product with outside air, after harvest.

Key words: Aniseed, long-term storage, quality

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