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Effects of drying temperature and sulfiting on the qualities of dried garlic slices

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Abstract : The browing, pyruvate content of sliced garlic during the drying in terms of drying temperature and sulfiting treatment were investigated. Sulfiting reduced the browning of garlic slices and prevented the reduction of pyruvate content against heat during the drying. Contents of pyruvate were decreased as the increase of drying temperature. Sulfiting treatment killed the microorganisms of sliced garlic products during the drying (Received October 25, 1991, accepted January 20, 1992).

Garlic, a popular seasoning in many countries, is widely used as a hot spice for many dishes. Most of the garlic has consumed as fresh garlic without any treatment of processing. In recent years, the consumption of dried garlic products has increased by 25% per year due to increasing demand of natural spices usually used in noodle soup and composite seasoning etc. in Korea. Therefore, dehydrated garlic products such as garlic slices and garlic powder were developed and consumed. Browning reaction and pyruvate loss are generally considered as dominating factors of quality deterioration during drying process. However, nonenzymatic browning can be prevented effectively by sulfite treatment. Sulfite has a wide variety of technical attributes in foods: the inhibition of nonenzymatic browning, antimicrobial effects, dough conditioning, antioxidant actions and bleaching agents uses. To minimize undesirable color changes and pyruvate loss of garlic slices, it is necessary to have a optimum condition so that an effective drying temperature and sulfiting treatment can be determined.

There are a few of papers on the drying of garlic bulbs or sliced garlic. Min[1] reported the optimum temperature of hot air drying for the sliced garlic was 55~60 ℃, and Pruthi *et al.*[2] reported the optimum temperature was 60 ℃. Anon[3] showed low temperature drying retained high amount of volatile components with less deteriorated. Han and Song[4] showed day-light drying was the best method for saving of the allyl sulfide which is one of major volatile component of garlic, and vacuum drying was the best one for rehydration yield. Heikal *et al.*[5] reported that the suitable treatment was found as to treat the sliced garlic with fumes of SO_2 which gave the best color of the dried end product.

It is well known that the quality of a dehydrated food is strongly affected by the drying conditions such as temperature and pretreatment of drying material. Unfortunately, information on the quality changes such as browning and pyruvate loss of dried garlic products is still lacking. The objectives of this study were to investigate the effect of drying conditions and sulfiting treatment on several quality attributes of dried garlic slices. Variables examined were drying temperature and sulfiting treatment.

Materials and Methods

Materials

Good quality garlic bulbs(Allium sativum Linnaeus) were purchased from a farm. At the time

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of purchase, the garlic bulbs has been harvested approximately two months earlier. During the time between harvest and purchase, the garlic bulbs were stored in cool and dry ambient conditions.

Methods

Peeled garlic was sliced with a cutter into thickness of 1.5 mm to 1.8 mm. The sliced garlic was air dried with a cabinet dryer(volume, 70×70×120 cm L×W×H; main power, 4 kW; power of fan, 1/4 HP). The slices were soaked in 0.5% sodium metabisulfite solution for 20 min. After soaking, the garlic slices were dried at 55, 65, 75 and 85 ℃± 1 ℃.

The relative degree of browning was determined by measuring the absorbancy at 420 nm according to the methods of Lee *et al.*[6] Pyruvate content of garlic as a measure of pungency was determined colorimetrically using the methods described by Schwimmer and Weston.[7] Rehydration rate(g water/g product) of the products was determined by weighing the samples before and after soaking the sliced garlic in water for 5 hr at 35 ℃. Total cell numbers were counted by observing the number of the colonies using the method described by Thatcher and Clark.[8] After grinding the sliced garlic into the powder(40 mesh), the powder was inoculated into the standard agar media(cell loading amount is g products/m*l* media) and incubated at 35± 1 ℃ for 48 hr. The moisture content of fresh and dried garlic slices was analyzed according to AOAC[9] methods. All values are expressed as means of three observations.

Color, flavor and texture of the dried garlic products were determined by the 15 trained panelists using modified hedonic scale method(Vie *et al.*).[10] Percentage of standard deviation for browning, pyruvate content, total viable count, rehydration rate and sensory score were less than 0.002, 1.84, 0.04, 0.17 and 0.05%, respectively.

Results and Discussion

Changes in browining, moisture and pyruvate contents during drying of sliced garlic at 65 ℃ were shown in Fig. 1. The brown color development during drying of sliced garlic was greatly dependent on drying temperature and moisture content. Reciprocal relationship was found between the formation rate of browning pigment and the reduction rate of moisture content. Drying at 65 ℃ showed sharp increase in nonenzymatic browning during initial stage of drying, whereas pyruvate content was gradually decreased as drying time went by. The faster rate of nonezymatic browning during initial drying time was attributed to the rapid decrease in moisture content and the heat generated during drying. Pyruvate content of garlic was also decreased with longer drying time.

The qualities of dried garlic slices with or without sulfite treatment were shown in Table 1. The higher the drying temperature was,the shorter the drying time became. However, higher temperature during drying process caused more severe browning reaction in the sliced garlic products. Drying at 55 ℃ without sulfite treatment showed the least degree of browning in the garlic products, whereas 85 ℃ drying showed the highest browning reaction. However, sulfite treatment of sliced garlic prevented the formation of browning pigment effectively during drying process at all levels of drying temperature. Pyruvate as well as allyl sulfide was one of major components of garlic products, thus pyru-

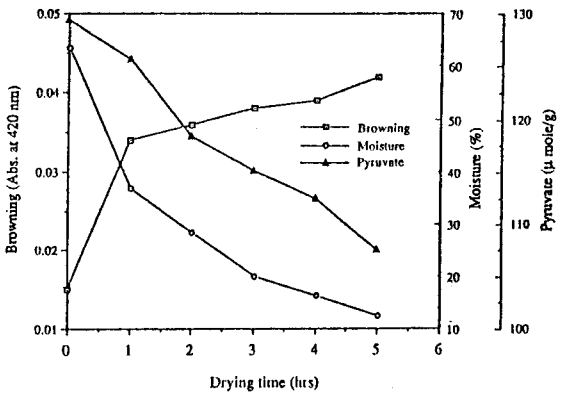

Fig. 1. Effects of drying time at 65°C on the contents of moisture, pyruvate, and browning pigments in sliced garlic.

Table 1. Characteristics of dried garlic slices with or without sulfite treatment

	Drying temp. (℃)	Drying time (hrs)	Qualities of dried garlics slices				
			Browning (Abs. at 420 nm)	Pyruvate (μ moles/g)	Total viable count(CFU/g)[a]	Rehydration rate[b]	Sensory score[c]
Without sulfiting	55	6.1	0.0.28	114.3	5.7×10^5	1.25	4.4
	65	5.2	0.039	107.5	4.6×10^5	1.16	3.6
	75	4.6	0.045	95.1	2.3×10^5	1.02	2.6
	85	4.0	0.056	87.4	4.7×10^4	0.91	1.5
With sulfiting	55	6.1	0.010	114.8	9.9×10^4	1.26	4.6
	65	5.2	0.011	108.2	5.2×10^4	1.15	4.2
	75	4.6	0.012	95.7	7.8×10^3	1.03	4.1
	85	4.0	0.014	88.3	3.5×10^3	0.89	3.8

[a] CFU : Colony forming unit.
[b] Rehydration rate was expressed as g H_2O/g solid.
[c] Scoring system for over-all satisfaction is based on a five point scale : 5, like very much; 4, like slightly; 3, neither like nor dislike; 2, dislike slightly; 1, dislike very much.

vate content was determined during the drying process to estimate the changes in garlic compound. Pyruvate content of garlic as a measure of pungency was also decreased as the increase of drying time and temperature. Decrease in pyruvate content was related with alliinase produced from the alliin. Since alliinase may be destroyed during the cutting of garlic, and its activity was also inactivated by heat. Pyruvate contents was reduced at high temperature. To minimize the losses of pyruvate during drying, garlic should be dried below 55 ℃. However, pyruvate content was not affected by sulfite treatment.

Treatment of 0.5% sodium metabisulfite reduced microbial growth and destroyed the microbes during the dying. Table 1 showed that 0.5% treatment of sodium metabisulfite at 65 ℃ reduced total viable count from 4.6×10^5 to 5.2×10^4 in the dehydrated garlic products. The influences of sodium metabisulfite treatment were also proved at various temperature during drying of sliced garlic.

Drying tempeature affected the rehydration rate of dried garlic products. Rehydration rate of dried garlic products was decreased with increased drying temperature(Table 1). However, sulfite treatment did not affect the rehydration rate of dried garlic products. Garlic products dried at low temperature had higher sensory score, rehydration rate, and pyruvate content with lower concentration of browning pigments than those dried at higher temperature. The qualities of dried garlic slices with sulfite treatment was much better than those without sulfite treatment. Therefore, drying with sulfite treatment was recommendable to produce the good quality of dried garlic products for sliced garlic drying with less time.

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건조온도 및 아황산처리가 건조마늘의 품질에 미치는 영향

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초록 : 세절 마늘 건조중 갈변물질의 형성속도는 건조온도가 증가함에 따라서 증가하였다. 건조마늘의 pyruvate 함량은 건조온도가 증가하거나 건조시간이 경과함에 따라서 감소하였다. Sodium metabisulfite는 세절된 건조마늘의 비효소적 갈변을 줄일 수 있었고, pyruvate 함량의 감소를 억제하였다. 아황산 처리는 antimicrobial activity를 갖는데, 65℃에서 대조구의 세균수가 4.6×10^5이던 것을 5.2×10^4으로 줄일 수 있었다.