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Solvent effect on antioxidant activity of Chinese ginger extracts to fats and oils

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ABSTRACT

Six solutions are employed to extract the effective antioxidant component from Chinese ginger, the antioxidant activity of the extracts to lard and bean oil is studied. The ginger employed here is from Hu county of Shaanxi province China. Orthogonal experiment $L_9(3^3)$ is designed and conducted to study the effect of preparation factors on the antioxidant activity of the extracts. The experimental results indicate that the antioxidant activity of the extract increases with the polarity of the extracting solvent; the antioxidant component extracted from the ginger in 80% ethanol solution with the ratio of ginger to solution of 1:12 at 50°C for 4 hour exhibits excellent antioxidant activity to lard; microwave extraction is very effective method for enhancing the extraction. © 2013 Trade Science Inc. - INDIA

KEYWORDS

Ginger;
Lard;
Antioxidant;
Peroxide value (POV).

INTRODUCTION

Ginger is a useful plant that exhibits season, pharmic and edible functions, which is widely used in makeup, herbal medicine, condiment and food. Especially, ginger is broadly used as a spice in foods around the world. For centuries, it has been an important ingredient in Chinese, Ayurvedic and Tibb-Unani herbal medicines for the treatment of catarrh, rheumatism, nervous diseases, gingivitis, toothache, asthma, stroke, constipation and diabetes. The antioxidant property of ginger promises its applications in food. The effective antioxidant activity of ginger is due to the hydroxybenzene in ginger, which includes ginger phenothiazine, turmeric, ginger ketone, etc. The hydroxybenzene could supply electron and hydrogen ion, which could reduce free radicals, and lead to effective antioxidant activity[3]. Up to now, though the antioxidant property of ginger is studied, some basic problem still needs to be studied continuously[1,2,4-6], such as the effect of solution for extraction, the effect of extraction method, and the growing area difference, etc, on antioxidant activity. The constituents of ginger are numerous and vary depending on the growing place and the freshness as well as the dryness of the rhizomes.

In the present paper, the ginger growing in Hu county of Shaanxi province China is employed to study the solvent effect on antioxidant activity to lard and bean oil comparatively.

MATERIAL AND EXPERIMENTAL METHOD

Resource and chemical reagent

The ginger is produced from Hu county of Shaanxi province China; Fresh lard; Fresh bean oil; Methanol,

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absolute alcohol, acetic ester, chloroform, ice acetum, hexyl hydride, KI, $Na_2S_2O_3$, soluble starch, $KMnO_4$ $FeCl_3$, all analytical reagent.

Main equipment

Vacuum oven, water bath with temperature controlled, microwave oven, balance, graduated cylinder, iodine flask, burette, brown reagent bottle.

Method for experiments

Extraction of antioxidant component from ginger in different solvents & the detection of antioxidant activity of the ginger extract to lard

The ginger powder is prepared by powder crusher. 10m1 of methanol, absolute alcohol, acetic ester, chloroform, ice acetum and hexyl hydride are poured into 6 flashes, separately. 0.5g ginger powder is inserted into the above 6 flashes, respectively. The flashes are experienced with vibration at 30°C for about 20h. Then the solutions are filtrated, the filtrated solutions are kept in the water bath of temperature controlled at 50°C till the extracts are obtained.

0.5ml absolute alcohol is employed to solute the extract, the fresh lard of 50g is then inserted into the solution with stirring. The contrastive is the fresh lard of 50g in 0.5ml absolute alcohol solution. All the samples are kept in the temperature controlled box at 65°C, which is stirred for 2 min every 24h. The peroxide value (POV) is detected at the day 2, 4, 6, 8 and 10 for each sample according to the procedure in 2.3.5, respectively.

Extraction of antioxidant component in ethanol with varying concentration & the detection of antioxidant activity of the ginger extract to lard

4 flashes are poured with 10ml of ethanol with the concentration of 90%, 80%, 70% and 60%, separately. 0.5g ginger powder is inserted into the 4 flashes afterword at 30°C for 20h with vibration. The solutions are filtrated and dried in vacuum oven for 30 min at 50°C to obtain the extract.

0.5 ml absolute ethanol is employed to solute the extract, the fresh lard of 50g is then inserted into the solution with stirring. The contrastive is the fresh lard of 50g in 0.5ml absolute alcohol solution. All the samples are kept in the temperature controlled box at 65°C, which is stirred for 2 min every 24h. The POV is detected at the day 2, 4, 6, 8 and 10 for each sample according to the procedure in 2.3.5, respectively.

Orthogonal experiment for optimizing preparation factors in ethanol solution

Orthogonal experiment $L_9(3^3)$ is designed and conducted to study the effect of preparation factors on the antioxidant activity of the extracts. The ginger / solution ratio, the extraction temperature and the extraction time, are varying. TABLE 1 shows the details of the $L_9(3^3)$ design. The solution is 80% alcohol.

TABLE 1 : Design of ingredient and level

level	ginger/solution ratio (g/ml)	temp. (°C)	time (h)
1	1:8	60	3
2	1:10	40	4
3	1:12	50	2

Effect of microwave

The extraction is conducted in microwave oven to study the microwave effect. 80% ethanol solution is employed, the ratio of ginger / solution is 1:12, and the temperature of the microwave oven is kept at about 75°C for 60s, 120s, 180s and 240s, respectively. The solutions are filtrated and dried in vacuum oven for 30 min at 50°C. 0.5ml absolute alcohol is employed to solute the extract, the fresh lard of 50g is then inserted into the solution with stirring, the POV is detected at the day 10 for the sample according to the procedure in 2.3.5, respectively.

The detection of POV for the extracts to lard

The sample prepared by above extraction procedure is employed to detect its POV for the extracts to lard. 1-2g sample is inserted into a flash, 30mL chloroform and ice acetum solution (chloroform: ice acetum =2:3, v/v) is poured into the flash as well, saturated KI solution is poured and sealed afterword. Stirring for 0.5 min is needed, which is followed by static deposition for 3 min. Then, 100mL water is poured into the flash, the titration is performed by 0.002N NaS_2O_3 till light yellow appearance, which is followed by 1ml starch solution poured, then the titration is continued till blue color disappears. The contrastive sampled is also titrated. The POV is calculated by equation 1.

$$\text{POV (meq/kg)} = S \times N / W \times 1000 \quad (1)$$

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In Equation 1, S is the volume of NaS_2O_3 consumed (ml); N is the concentration of NaS_2O_3 (N); W is the weight of the sample (g).

Comparison of antioxidant activity of ginger extract and food additive BHT in bean oil

Ethanol solution with the concentration of 80% is poured into 6 flashes, afterword 0.5g ginger powder is inserted into the 6 flashes at 50°C, and the ginger / solution ratio is 1:12. The absolute alcohol is employed to prepare the solution of ginger extract with the concentration of 0.02%, 0.04%, 0.08% and 0.20%, respectively. The above solutions are inserted into 4 flashes of bean oil of 50g to detect their antioxidant activity, respectively. The food additive BHT solution of 0.02% concentration is inserted into bean oil as a comparative sample. The POV is detected at day 0, 5, 10, 15 and 20 according to the procedure in 2.3.5, respectively.

EXPERIMENTAL RESULTS AND DISCUSSION

Solvents effect

The anti-oxidation activity of ginger extracts in lard is shown in Figure 1. The lower value of POV shows the higher antioxidant property. Figure 1 indicates that the anti - oxidation activity of the extract in methanol solution is the highest, which is due to its strong polarity for the extraction of hydroxybenzene from ginger. The antioxidant activity of the extract with hexyl hydride solution exhibits the lowest owing to its poor polarity.

Since methanol is poisonous, ethanol is the proper choice for extraction for food additive.

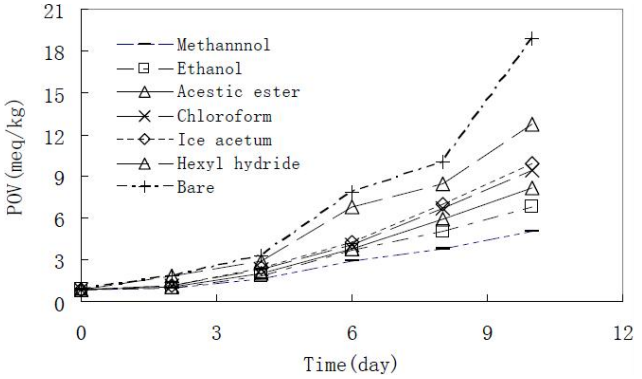

Figure 1 : Antioxidant activity of the ginger extracts from different solvents to lard

Concentration effect of ethanol

Ethanol and water are taken as solute and solvent to prepare water solution of 0%, 90%, 80%, 70% and 60% concentration, respectively. These solutions are employed to extract ginger extracts, respectively. The antioxidant activity of the extracts to lard is detected. The results are shown in Figure 2. From Figure 2, it can be seen from that the antioxidant activity of the extracts from solution of 80% ethanol is the highest.

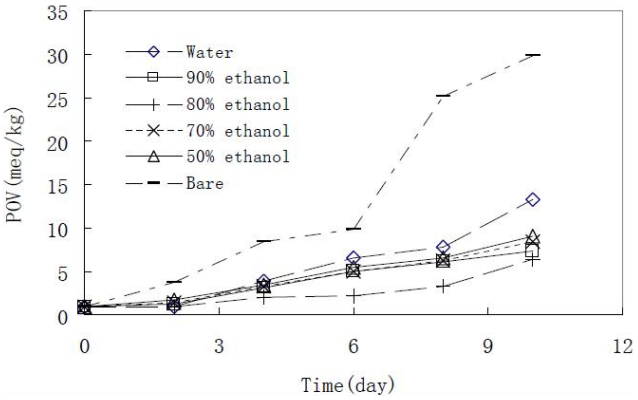

Figure 2 : Antioxidant activity of the ginger extracts from the different concentration of ethanol solution to lard

Optimization of the extraction procedure in ethanol solution

80% ethanol solution is employed to extract antioxidant component from ginger. The influence of temperature, ratio of ginger / solution and time is studied with orthogonal experiment $L_9(3^3)$. The antioxidant activity to lard is detected for day 10 according to the procedure in 2.3.5, 0.5g extract and 50g lard of ginger are employed. TABLE 2 shows the experimental design and its results.

TABLE 2 indicates that the influence of temperature is significant, while the time effect is the not sensitive.

Further analysis to TABLE 2 indicates that the optimized procedure for ginger extract in 80% ethanol solution is: ginger/solution ratio 1:12, temperature 50°C and soaking time 4h.

Effect of microwave

The microwave effect is shown in TABLE 3. From TABLE 3, it indicates that the extract exposed in microwave oven for 120s exhibits the best antioxidant activity.

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TABLE 2 : Orthogonal experimental design and its results for optimizing extraction factor in ethanol solution

Test No	Ginger/ Solution Ratio	Temperature (°C)	Time(h)	(meq/kg)
1	1	1	1	13.76
2	1	2	2	9.64
3	1	3	3	6.89
4	2	1	2	11.67
5	2	2	3	7.70
6	2	3	1	7.11
7	3	1	3	12.74
8	3	2	1	7.50
9	3	3	2	5.70
K1	10.097	12.723	9.457	
K2	8.827	8.820	9.003	
K3	8.647	6.567	9.110	
Level difference R	1.450	6.156	0.4564	

TABLE 3 : The antioxidant activity of extracts in microwave to lard

time (s)	60	120	180	240
POV (meq/kg)	7.01	6.53	7.32	10.64

Antioxidant activity in bean oil

Figure 3 shows the antioxidant activity of bean oil with ginger extracts added.

From Figure 3, it indicates that the antioxidant activity of the extract to bean oil increases with the concentration of ginger extract in solution significantly. The antioxidant activity of the extract to bean oil at the ginger extract concentration of 0.04% reaches to that of the addition of 0.02% BHT.

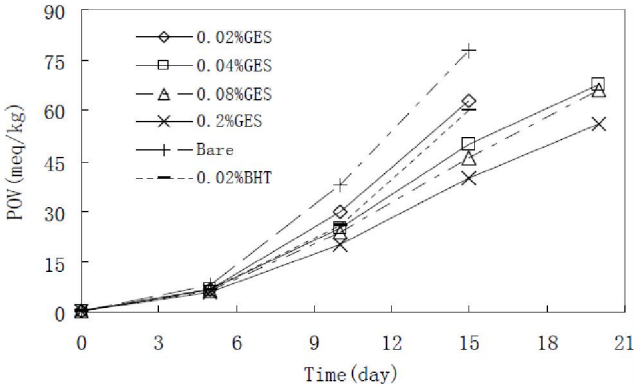

Figure 3 : The antioxidant activity of the ginger extraction to bean oil

CONCLUSION

The extracts of ginger in methanol, absolute alcohol, acetic ester, chloroform, ice acetum and hexyl hydride all exhibit antioxidant activity for lard and bean oil. The antioxidant activity of the extract increases with the polarity of the solvent. The antioxidant components extracted from the ginger with the ratio of ginger to solution of 1:12 at 50°C for 4 hour in 80% ethanol solution exhibits excellent antioxidant activity to lard; microwave extraction is very effective method for enhancing extraction.

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