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Effect of cryogenic and ambient grinding on flavoring components of black pepper and turmeric

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Abstract :-In the normal grinding process, heat is generated when energy is used to fracture a particle into a smaller size. This generated heat usually is detrimental to the product and results in some loss of flavour and quality. The fat content of spices poses problems of temperature rise during grinding. Spices loose fraction of their volatile oil or flavouring components due to this temperature rise. Therefore, cooling of spices at low temperature before feeding to the grinder and maintaining the low temperature in the grinding zone can significantly retain the volatile oil or other flavouring components.
Attempt is made to investigate the retention of flavouring components of spices black pepper and turmeric.
Liquid nitrogen used to provide refrigeration needed to precool the spices and to maintain low temperature by absorbing heat generated during the grinding operation. The colour values of cryogenic ground spices were found better than ambient ground spices. The grinding on flavoring components of black pepper and turmeric under cryogenic grinding condition were found superior in quality than that of ambient grinding condition .

Keywords :- Ambient grinding, black pepper, colour, cryogenic grinding, turmeric**.**

I. INTRODUCTION

Spices are important agricultural commodities throughout the world due to their high unit price. This is particularly true for India which produces about 2.5 million tonnes (valued at 3 billion US$) of spices, processes, markets in domestic sector and exports them to various countries to earn a handsome foreign exchange. India's share in the world trade amounts to 46% of the total in quantity (about 30% in monitory terms) (Anon, 2001a). It is, therefore, necessary to give due attention to this commodity with particular reference to quality and value addition.

The aim of grinding of spices is to obtain the smaller size of particles with good quality products in terms of flavour, color, and piprine content, which are destroyed due to temperature rise during grinding. The temperature rise varies with volatile oil and moisture content of the spices. The spices become embrittled and easily crumble at low temperature due to the fact that at low temperature volatile oil solidifies permitting grinding to a finer powder. The loss of volatile oil can be reduced by cryogenic grinding technique.

The temperature rise of spices during grinding can be reduced to some extent by circulating water or cold air around the grinder. But this is not sufficient to significantly reduce the temperature rise of the product during grinding. With liquid nitrogen temperature of the product can be obtained as low as 77K (boiling point of liquid nitrogen). But such a low temperature is not required for all the spices, some may require temperature few degrees below atmospheric temperature. The temperature to be used is determined by parameters viz. the final product size, color required etc. of the product [1-6].

Of all the spices produced in India, black pepper (Piper nigrum L.), also called the 'King of Spices', is one of the major spices being exported amounting to more than 35,000 tonnes during 1998-1999 valued at about Rs. 650 crores (Peter, 1999) and estimated to increase to about 42,000 tonnes valued at Rs. 865 crores during 1999-2000 (Anon, 2001a). Black pepper is a common spice produced in oriental countries (mostly in south east Asia including India, Indonesia and Malaysia) but is used worldwide for its characteristic pungent flavour and taste.

World production of turmeric estimated to be about 2,60,000 tons, of which India alone accounts for only 80 percent, but only some 20,000 tons of turmeric are exported from India, the rest being consumed within the country (Thomas,2000). This paper discusses the effect of quality attributes of spices viz. black pepper and turmeric during cryogenic grinding and ambient grinding.

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II. EXPERIMENTAL SET UP

A household grinder and pre-cooling jar available in the market were used. Arrangement was made for circulating liquid nitrogen around the pre-cooling jar to precool the sample spices. Copper-constantan thermocouples were used for measurement of temperatures. Both jars were well insulated to reduce the heat loss to the surroundings during cryogenic grinding. Figure1 shows the experimental setup for cryogrinding of spices.

Sample of dried spices were ground at atmospheric temperature and temperatures before and after grinding were recorded. The sample was ground to a fineness that it passed through 500 micron sieve. The time was recorded for sample grinding.

Same weight of fresh and dried sample of spice was precooled in the precooler by passing the liquid nitrogen through the tubes surrounding the precooler. The steady state temperature was recorded. The precooled sample was immediately transferred to the grinder. The temperature was recored. It was then ground for the same duration of time as in conventional grinding. The temperature of the ground spice was then recorded. It was repeated for other spices.

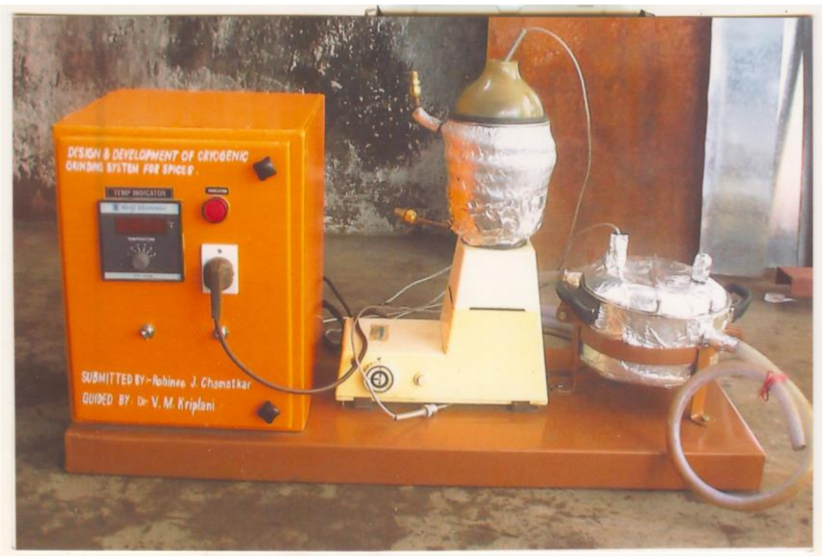

Fig.1. Experimental setup for cryogrinding of spices

III. RESULT AND DISCUSSION

Testing of ground samples were carried out at Premier Agmark Laboratory, Nagpur. Tables 1 & 2 show the time temperature study for black pepper and turmeric carried out during ambient grinding and cryogrinding for the same weight of samples. The quality characteristics of ground spices were found out by considering the properties, moisture content %, volatile oil content %, non- volatile ether extracts %, piprine content % and curcuminoid content %. Table 3 shows the moisture content comparison for ambient and cryogrinding of spices. Among all four sample spices, black pepper shows the moisture content decrease by 57.1%, whereas in turmeric it found decrease by 27.3%. Table 4 shows the volatile oil content for ambient and cryogrinding of spices. Volatile oil content for black pepper is increased by 133.3% compared to ambient grinding. Table 5 shows the non-volatile ether extract for ambient and cryogrinding of spices. Non-volatile ether extract for black pepper is increased by 220.0% compared to ambient grinding. Table 6 shows Curcuminoid content for turmeric is increased by 295.0% compared to ambient grinding.

Table7 shows total ash content for turmeric is decrease by 17.64% compared to ambient grinding.

Table 1. Time temperature study of spices grinding at atmospheric temperature

Spices	Weight (gm)	Time (sec)	Temp. before grinding, (K)	Temp. after grinding, (K)	Temp. rise (K)
Black pepper	125	165	306.4	323.6	17.2
Turmeric	125	165	306.5	323.5	17.0

Table 2. Time temperature study of spices grinding at cryogenic temperature

Spices	Weight (gm)	Time (sec)	Temperature in precooling jar (K)	Temperature In grinder before grinding (K)	Temperature in grinder after grinding (K)	Rise in temp. (K)
Black pepper	125	165	133.0	238.0	287.0	49.0
Turmeric	125	165	132.0	223.0	281.3	58.3

Table 3. Moisture content for ambient and cryogrinding of spices

Spices	Weight (gm)	Moisture content (%) for ambient grinding	Moisture content (%) for cryogrinding	% decrease
Black pepper	125	10.5	4.5	57.1
Turmeric	125	10.6	7.70	27.3

Table 4. Volatile oil content for ambient and cryogrinding of spices

Spices	Weight (gm)	Volatile oil content (%) ambient grinding	Volatile oil content (%) cryogenic grinding	% Increase
Black pepper	125	2.4	5.6	133.3

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Table 5. Non-volatile ether extract for ambient and cryogrinding of spices

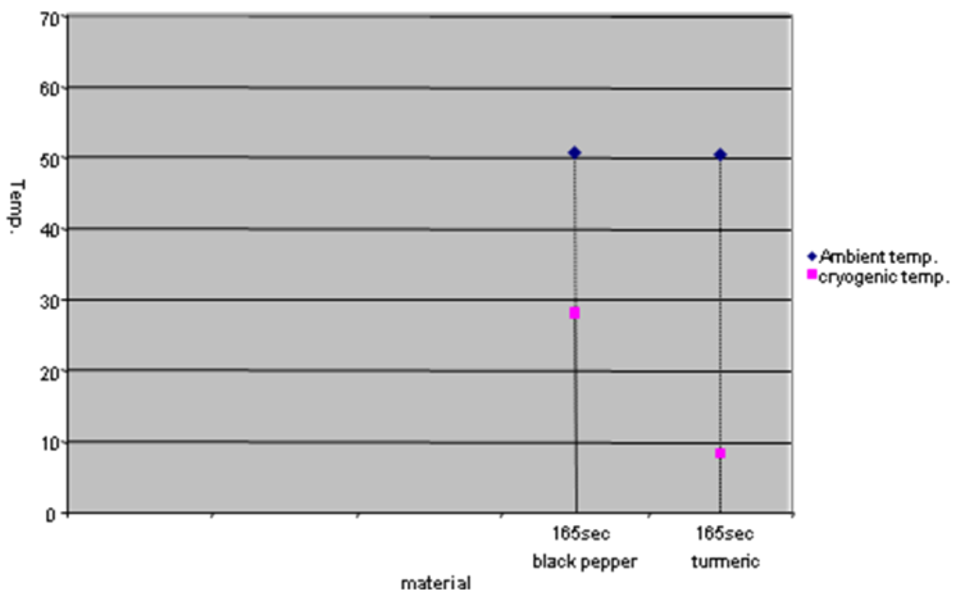
Spices	Weight (gm)	Non-volatile ether extract (%)for ambient grinding	Non-volatile ether extract (%) for cryogrinding	% Increase
Black pepper	125	9.61	30.8	220.0

Table 6. Curcuminoid content for ambient and cryogrinding of spices

Spices	Weight (gm)	Curcuminoid content (%) ambient grinding	Curcuminoid content (%) cryogenic grinding	% Increase
Turmeric	125	1.36	5.38	295

Table 7. Total ash content for ambient and cryogrinding of spices

Spices	Weight (gm)	Total ash content (%) for am grinding	Total ash content (%) cryogenic grinding	% Increase
Turmeric	125	8.5	7	17.64



“Fig.2 variation of temperature in ambient & cryogenic grinding system”

Fig.2 shows the variation of temperature in ambient and cryogenic grinding for the same material and same timing. It is observed that grinding temperature is more in ambient than cryogenic grinding

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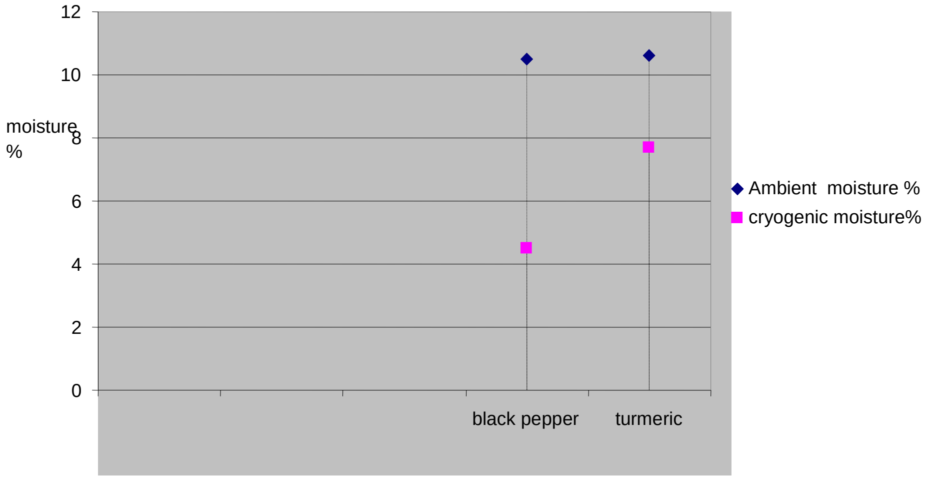

Fig. 3 variation of moisture content % in ambient & cryogenic grinding system

Fig.3 shows the variation of moisture content % in ambient and cryogenic grinding. It is observed that the moisture content % is less in all sample spices in cryogenic grinding than in ambient grinding.

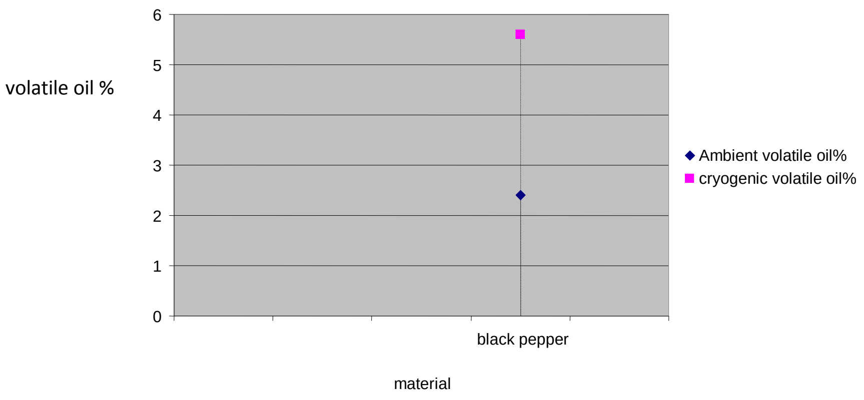

Fig.4 variation of volatile oil content % in ambient & cryogenic grinding system

Fig.4 shows the variation of volatile oil % in ambient and cryogenic grinding. It is observed that the volatile oil % is more in all sample spices in cryogenic grinding than in ambient grinding.

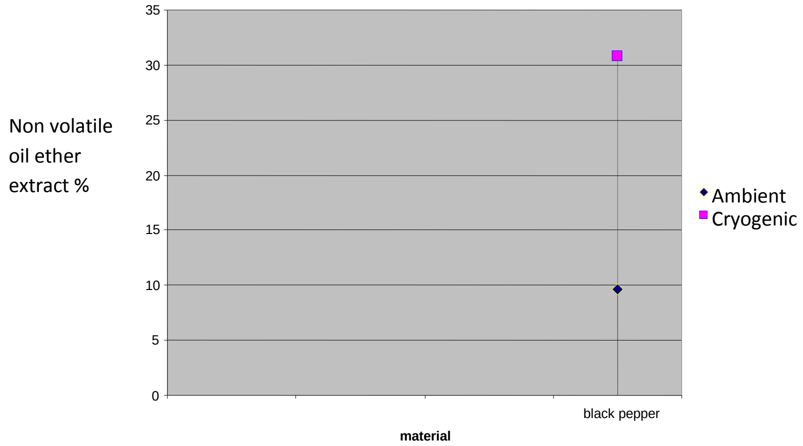

Fig. 5 variation of non volatile oil content % in ambient & cryogenic grinding system

Fig.5 shows the variation of non -volatile ether extract % in ambient and cryogenic grinding. It is observed that the non- volatile ether extract % is more in all sample species in cryogenic grinding than in ambient grinding.

IV. CONCLUSION

The test results show that with grinding at low temperature loss of the flavouring components in the spices can be reduced and hence the quality of the product increased. The grinding characteristics of black pepper and turmeric under cryogenic grinding condition were found superior in quality than that of ambient grinding condition .

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