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Effect of Ripening by Microwave Radiations on Quality of Dhakki Dates

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Abstract: The impact of microwave radiations on length, width, length-width, volume, weight, density and total soluble solids of Dhakki date fruits was investigated. The fruits picked at their mature "Doka" stage, were radiated for 10 to 50 sec using microwaves at three different levels of low (210 W), low medium (360 W), medium (480 W) and medium high (540 W) intensities. Quality parameters such as fruit length, width, weight suffered varying amounts of losses on increasing radiation up to low medium intensity. However, a significant retention in fruit size appeared given higher radiation of medium intensity of 480 W and the fruits exposed for 50 sec at that radiations attained almost original fresh fruit size and appeared attractive for being bigger and smooth in shape, and juicy as compared to the other treated fruits at lower intensities and to the control samples after ripening. The fruits treated at further higher energy of medium high (540 W) levels showed signs of heat roasting with undesirable baked flavour. Never the less microwave radiations of appropriate intensity envisage great potentials in the processing of Dhakki dates.

Key words: Microwave radiations, Dhakki dates, ripening/curing

Introduction

Dhakki dates (*Phoenix dactylifera* L.) are of high quality fruits world over. However, for being a late variety it suffers excessive post harvest losses and quality degradation due to coincidence of the ripening period with that of monsoon raining season that persists till weeks. Quality of the dates is further impaired using traditional processing technique of exposing the fruits on mats to sun at open air. Besides dust and other harmful contaminations, sizeable amount of the product turns out to be fermented due to limited available drying and storage facilities. In order to minimize post harvest damage and curtail financial losses it becomes imperative to take scientific measures to ripen date fruits artificially.

The microwaves (Cathcart *et al*., 1947) are considered a concentrated source of heat energy with deep and rapid penetration power. Presence of moisture in foods greatly accelerates the heating rate and thus the technique being worked out as a fast heat exchange device requiring much less time for baking. Whereas in the conventional methods heat is transferred gradually through conduction from the food surface to inside that takes sufficient time inflicting great damage to the surface (Stein, 1972; Lorenz *et al*., 1973). Besides its use in baking preservation the microwaves had also been employed for blanching vegetable products (Proctor and Goldblith, 1948), and its performance compared with steam or water blanching using corn-on-the cob (Huxsoll *et al*., 1970 a, b).

The technique is reported to be successful for popping of popcorn (Lin and Anantheswaran, 1988) and industrial drying of pasta (Maurer *et al*., 1971). Garcia *et al*. (1988) found that drying of bananas by microwave took 17 to 20 times less drying period than that required using forced draft oven. Since the date fruits under going ripening require certain units of heat energy for the fruits, this lead to explore the potential of microwave radiations on quality changes during ripening of Dhakki dates, the aspects never examined before. In this particular study it was aimed to find out changes in size, weight, density and total soluble solids of the fruits undergoing ripening by the influence of microwave radiations.

Materials and Methods

Fruits of Dhakki variety raised at orchards belonging to progressive growers of Dera Ismail Khan was procured and transported to the laboratory of the Department of Food Science and Technology, Faculty of Agriculture, Gomal University, Dera Ismail Khan for experimentation. Good appearing and healthy mature fruits at "Doka" stage were taken while bruised, spotted and diseased and birds infested were discarded.

Samples preparation: The fruits were well washed using detergent to reduce microbial load, dust, dirt or adherent spray chemicals and finally rinsed with tap water. These were then dipped in 0.1% aqueous solution of sodium benzoate in order to inhibit microbes likely to grow during ripening/ curing. The washed dates were then blotted on paper wiping off excessive water. The samples were divided into several lots each consisting on ten equal size and maturity fruits.

Microwave treatment: Each lot desired for microwave radiation was taken separately in a petri glass dish and transferred to microwave oven, which was supplied by Matsushita Electric Industrial Co. Ltd Japan. The oven was equipped with input of 1200 W, 5.6A, 220V, 50HZ cycle and output maximum energy of 600W, 2450 MHZ at full power. It had a variable power control (80-600 W), a 30 minutes timer with a defrost function and "Magic-Platter" automatic turntable facilities. The samples were radiated for 10 to 50 sec at low, low medium, medium and medium high power intensities at 210, 360, 480 and 540W respectively.

Data collection: The radiated samples were incubated for ripening at 40°C under dark or fluorescent light of 100 W by means of indoor incubator set-up. A control sample given no radiation was also run side by side to compare the effectiveness of a treatment. The competence of radiation on quality changes during ripening/ curing was followed determining fruit size, weight, length weight ratio, density and total soluble solids prior to and after 120 hr ripening. Hardness of the fruits was recorded whenever required. The hardness index helped in sorting out optimum maturity of "Doka" stage and to assess advances in fruits ripening while on curing.

Quality estimation: For estimation of quality parameters the A.O.A.C. (1984) was consulted where ever required. Size of the fruits was determined by means of micrometer measuring length and width of each fruit. Weight was taken by analytical balance, whereas total soluble solids (T.S.S) assessed by Abbe hand refractometer. Hardness of the fruits was measured by means of a pressure-testing device developed in the laboratory. The device had a stainless steel bar with 1 mm penetrating surface area and worked on the pattern of Aneroid Sphygmomanometer (mm Hg).

Results and Discussion

Microwave radiation studies: After preliminary sorting and washing, the fruits at mature "Doka" stage were separated into

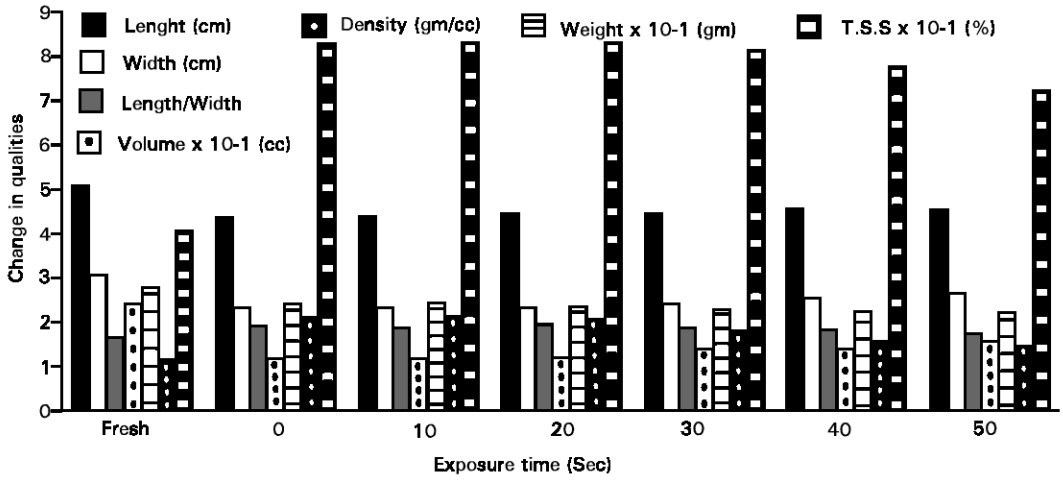

Fig. 1: Effect of exposure time to low intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing fluorescent light

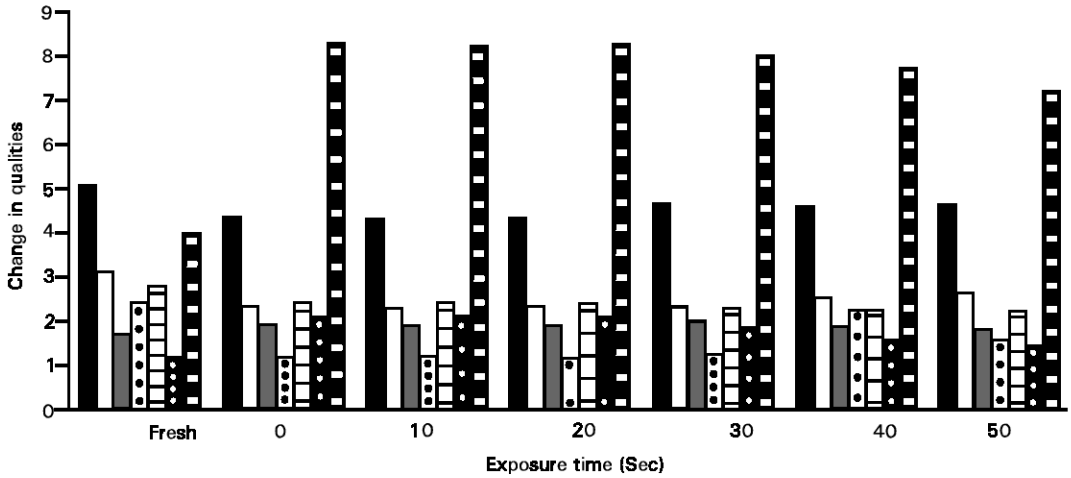

Fig. 2: Effect of exposure time to low intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing dark

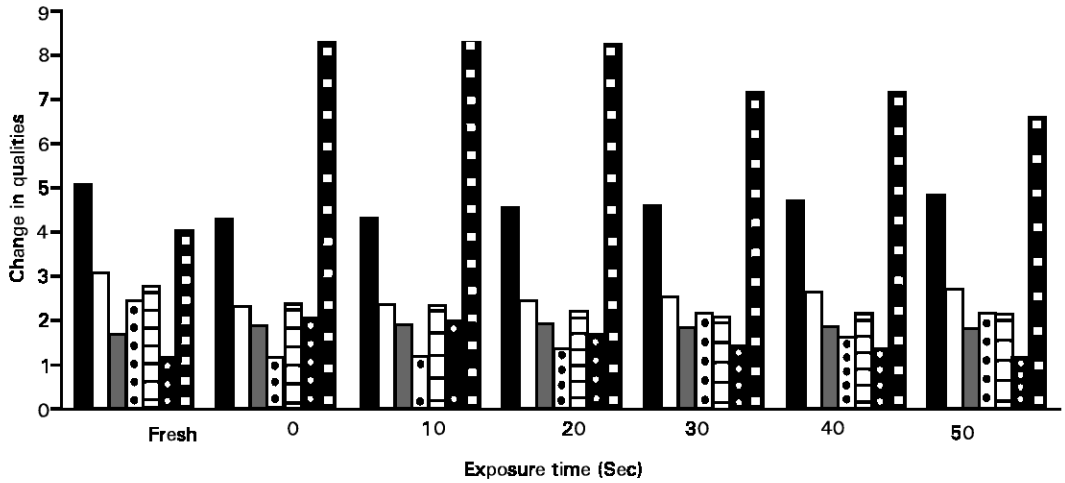

Fig. 3: Effect of exposure time to low medium intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing fluorescent light

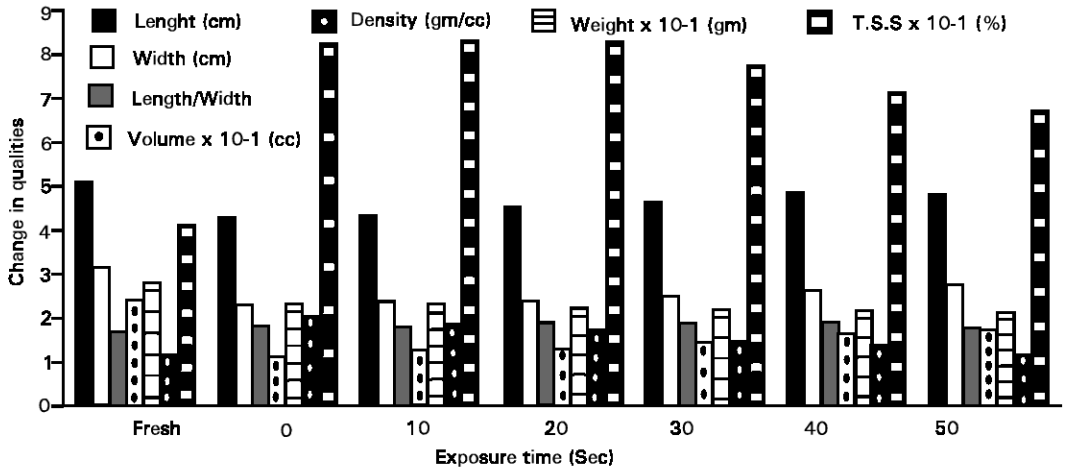

Fig. 4: Effect of exposure time to low medium intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing dark

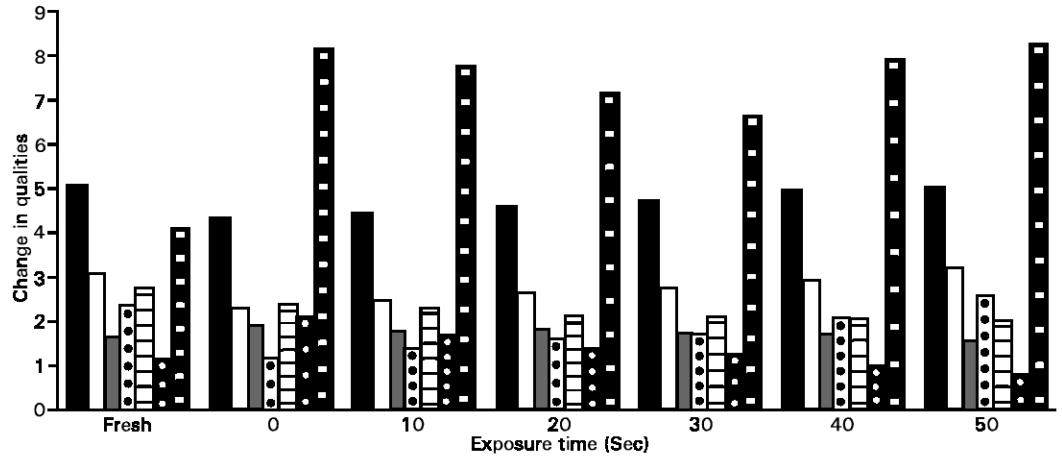

Fig. 5: Effect of exposure time to medium intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing fluorescent light

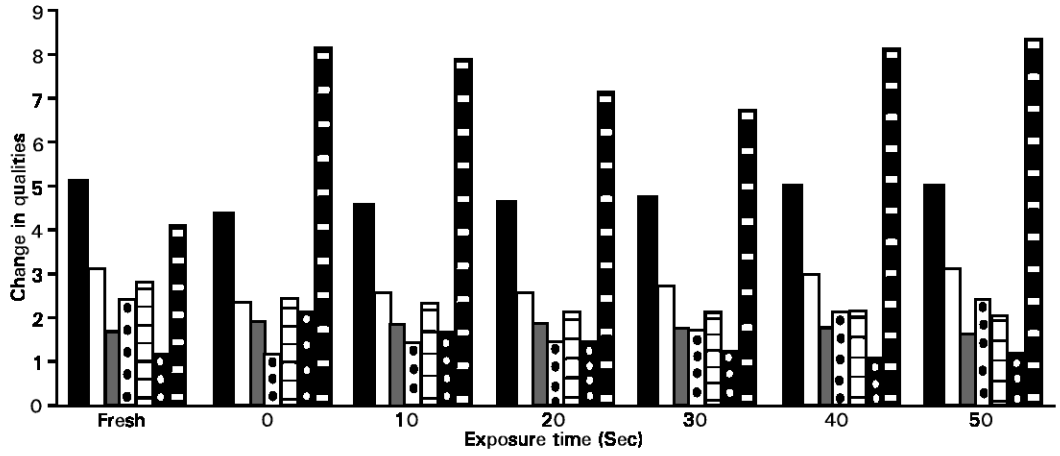

Fig. 6: Effect of exposure time to medium intensity radiations on the quality of Dhakki dates measured after 120 hrs under curing dark

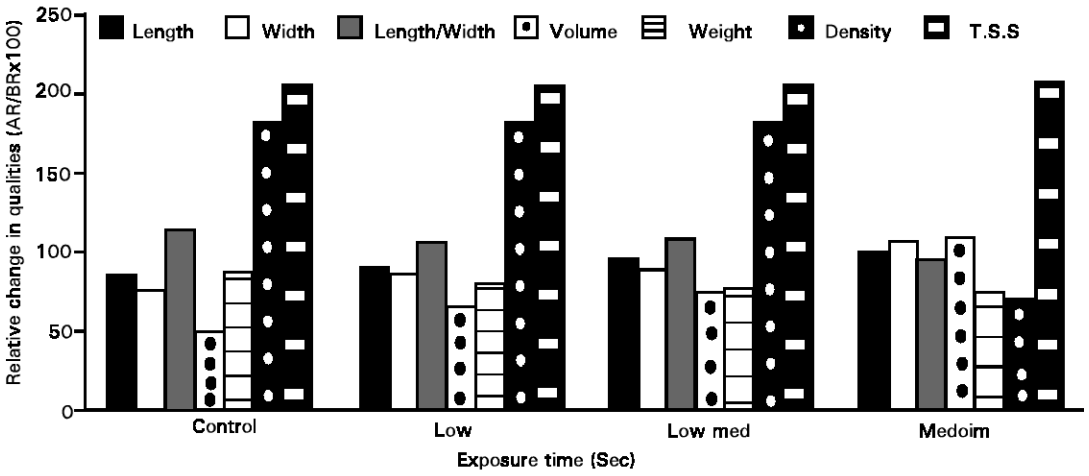

Fig. 7: Effect of radiation on quality parameters of Dhakki dates radiated for 50 sec and ripened under light for 120 hours. AR = After ripening BR = before ripening

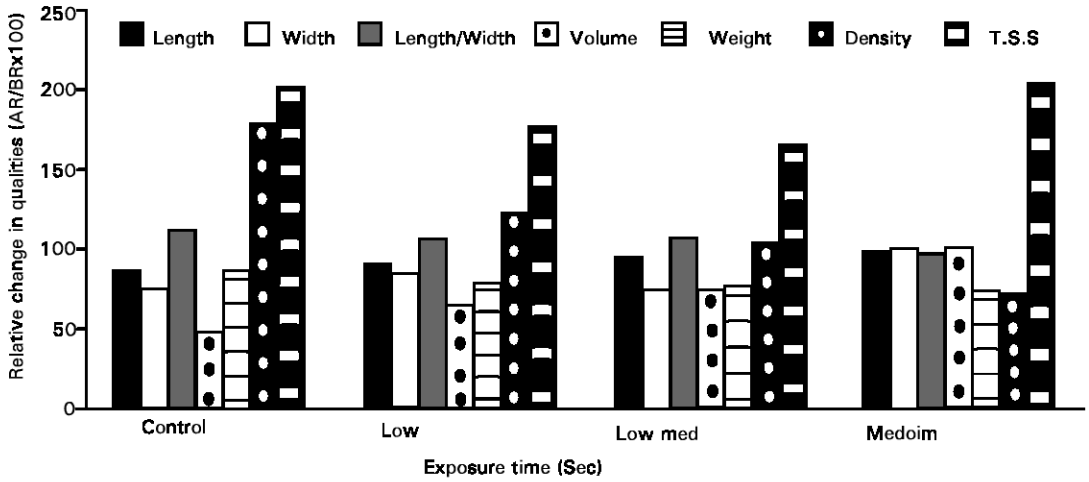

Fig. 8: Effect of radiations on quality parameters of Dhakki dates radiated for 50 sec and ripened under dark for 120 hours. AR = After ripening BR = before ripening

several lots each comprising on 10 fruits, taken on to glass petri dishes, radiated for the required periods and incubated at 40°C. Since radiation intensity of 540 W appeared to be injurious causing heat damage further studies with this intensity was abandoned. The reported data are based on consecutive observations for two years.

Effect of radiations on fruit size: The length and width of all fruit samples including the control lots suffered varying amount of reduction during incubation for the ripening and the level depended upon the time to which the samples were exposed to radiations and to the intensity of the radiation (Figs. 1 to 6). The length before ripening ranged from 5.0-5.1 cm with a mean length of 5.05 cm, which decreased on ripening to 4.3 cm after 120 hrs of incubation of the control non-radiated samples manifesting about 15 % reduction in the fruit length. The extent of the reduction however, declined with the increase in time of the exposure as well as energy of the radiation and the fruit length of the samples radiated at medium intensity of 480 W for 50 sec approached to its fresh sample value of 5.0 cm. Comparing to the fresh sample prior to incubation about 85 % of the length was retained by the non-radiated sample after incubation for 120 hrs, whereas 90, 95 and 99%, was retained by the samples radiated at low, low medium and medium intensity respectively (Figs. 7, 8). No significant effect on length of the fruits was noticed whether incubated under light or dark.

The width of the fresh dates ranged from 3.0 to 3.1 cm with average of 3.07 cm and which also reduced on ripening to 2.3 cm in the non-radiated samples giving maximum of about 25% reduction. Whereas, the level decreased further consequent upon radiation at low and low medium intensity, however the width of the samples radiated at the medium intensity appeared rather greater than that of the fresh sample. The size of radiated fruits in terms of volume therefore, approached to that of fresh un-cured samples and the size of the sample radiated for 50 sec at the medium intensity appeared even bulgy (Figs. 7, 8).

Effect of radiations on fruit weight: Irrespective of the treatments a decrease in weight is observed on incubation for curing; however the amount of loss in weight is subject to treatments (Figs.1, 6). Weight of the fresh samples experienced no radiation decreased on curing from 27.65 to 23.83 g giving 13.82% weight reduction and which is a minimum, whereas maximum of twice that amount is found for the samples radiated at the highest intensity of medium energy (Figs. 7, 8). Loss in weight is expected to occur due to varying amount of moisture losses taking place during incubation. Moisture evaporation is also expected to take place on heating caused by the radiation (Maurer *et al.*, 1971, Garcia *et al.*, 1988). Various amounts of change in fruit density were noticed depending upon the time of exposure to radiation and also by the radiation intensity. Comparing with the density of the fresh samples the quality increased on curing from 1.16 to 2.1 g/cc for the non-radiated samples and to 2.03 and 1.95g/cc those radiated for only 10 sec at low and low medium intensity respectively, however, the level declined further on increasing the exposure time. Whereas, those samples radiated at medium intensity suffered significant density losses, as a result only 68 to 72% density was retained for the samples receiving 50 sec exposure at the stated energy level (Fig. 7, 8) and the fruits appeared to be puffy.

Effect of radiations on total soluble solids: Total soluble solids of all the samples increased on curing. It was also affected by the time of exposure and intensity of the radiation. T.S.S. before curing ranged from 39.5 to 41% which increased on curing to maximum of 83.5%. Compared to the control samples the total soluble solids showed a decline by time of the radiation at low and low medium energy (Figs. 1, 4) and the samples appeared rather firm and less juicy. Never the less, the fruits represented soft texture with less than 100 mm hardness index, whereas hardness before ripening ranged from 180 to 340 mm Hg units, while after ripening it ranged from 2 to 100 units and the fruits showed softness. Whereas the total soluble solids for the samples exposed to medium energy are compatible with the non-radiated ones and the quality was much retained (Figs. 5, 8). It is to emphasize that a prominent impact of ripening by microwave radiations on the qualities of the Dhakki date fruits is envisaged. The radiated dates improved the consumer desirable qualities by increasing fruit volume while retaining the desirable level of T.S.S., though bulk density was reduced to certain degree. Moreover, the radiated fruits almost retained their original appearance, the quality characteristics is highly desirable. While the shape of the fruits after the conventional ripening technique, became distorted. This peculiar character of microwave radiation is likely attributed to its fast and deeply heating of the fruits and inside gaseous vapours so produced, disallow fruit structure from the collapse. Further, the radiated fruits allowed 2 weeks early picking without loss in the quality thus protecting fruits from the damage inflicted by the monsoon rains, besides shortening of the ripening period proportionately (Saleem *et al.*, 2001). On the other hand, radiation exceeding 480W energy damages the qualities by overheating the fruits manifesting baked or cooked flavour. Nevertheless, microwave radiations up to a medium level of intensity, accelerated the pace of ripening of Dhakki dates and thus curtailing ripening period significantly. Since the fruits become soft using radiation at the medium intensity, they may acquire an acceptable curing level even if the fruits are procured at somewhat below the required maturity level, thereby increasing the overall yield of the production. As the microwave-ripened fruit is relatively less sweet than its non-radiated counterpart cured under conventional ways, the product is likely to be more nutritionally and sensorially acceptable. From prevention of higher molecular carbohydrates to lower level of sweeter sugars consequent upon radiation, it is inferred that the enzyme-mediated hydrolytic reactions associated with ripening process are receded at least partially. This is the first study of its own kind and the technique conceives great prospects to commercial application as it also offers substantial savings in time, energy, floor space and maintenance expenses.

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