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不同揉捻方式對部份發酵茶物性及品質之影響

Effects of Shaping Methods on Physical Properties and Quality of Partially Fermented Tea

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摘 要

部份發酵茶之製造過程中，揉捻作業是最重要的一環。本研究針對本省常用之五種揉捻方式進行製茶試驗，以探討不同揉捻方式對成茶物性及品質之影響。成茶之品質以感官品評方式測定之。

試驗結果顯示以手工揉捻及以機械揉捻等不同方式所製之成茶，其品質間有明顯地差異。為了降低製茶成本及提高成茶品質，滾桶式揉捻機值得進一步改良。

關鍵詞：揉捻方式，部份發酵茶。

ABSTRACT

Shaping is the most important procedure in production of partially fermented tea. Five shaping methods were applied to investigate the effects of shaping methods on physical properties and quality of tea products. The quality of tea product was examined according to sensory evaluation.

The results showed that manual shaping and mechanical shaping produced distinct effects on tea quality. A rotary shaping machine is suggested for further work to decrease costs of production and to promote tea quality.

Keywords: Shaping method, Partially fermented tea.

INTRODUCTION

According to reports of the Council of Agriculture (1993), tea is the most important special crop in Taiwan. The planted areas and production of the tea crop from 1953 to 1992, shown in Table 1, were 44,655 to 22,620 hectares and11,903 to 20,164 tons per year, respectively. The export quantity and value of tea from 1985 to 1992 are shown in Table 2; 5577 tons of tea, including green and black tea, were ex-

Table 1. Planted area (ha) and production (ton) of tea crop in Taiwan

Year	Planted ares (ha)	Production (ton)
1953	44,655	11,903
1963	38,372	21,104
1973	33,021	28,639
1983	29,433	24,308
1992	22,620	20,164

Table 2. Export quantity (ton) and value (USA $1000) of tea crop in Taiwan

Year	Quantity (ton)	Value (USA $1000)
1985	9,912	24,627
1992	5,577	19,670

ported in 1992. The difference between production and export, i. e. 14,587 tons in 1992, were partially fermented tea including Taiwan Oolong and Puchung Tea. Hence about 72% of tea production is consumed in Taiwan in the form of partially fermented tea. The reason for partially fermented tea being the most favorable is its special aroma and taste (Chang, 1983; Chou, 1987; Luan, 1982).

The manufacturing procedures and equipment for partially fermented tea are shown in Table 3 (Luan, 1982). Shaping is the most important procedure in tea production technology. The quality of the tea product depends mostly on the shaping methods. Shaping methods of several kinds, such as manually or mechanically of various types, were generally used in production of partially fermented tea. Peng and Li (1992) reported that the cost of shaping (mass rolling) was about 53% of the total cost of production of partially fermented tea. The reasons for this large fraction of cost in shaping are the costs of labor and the shaping methods. Therefore, further assessment of shaping methods is necessary. In this work, experiments with varied shaping methods for partially fermented tea were conducted, and the effects of shaping methods on physical properties and quality of tea products were investigated. The results provide useful information to improve the shaping methods and to diminish production costs.

Table 3. Manufacturing procedures and equipment for partially fermented tea

Manufacturing procedures	Equipment
(1)Fresh tea leaves	Harvester
(2)Solar withering (or hot withering)	
(3)Indoor withering and shaking	Rotary shaking machine
(4)Panning	Rotary panning mcahine
(5)Rolling	Rolling machine
(6)Repanning	Rotary panning machine
(7)Shaping (Mass rolling)	Shaping machines
(8)Drying	Manual dryer or continuous dryer
(9)Rosting	Roasting machine
(10)Tea product	Paching machine

MATERIALS AND METHODS

Materials and Equipment

Tea leaves (Nan-Tou area, summer 1992) , container, ruler, rotary panning machine, rolling machine, mass shaping machines, rotary shaping machine, continuous dryer, roasting machine, rheometer, electric digital balance, and blender were used in this work.

Experimental Design

Five shaping methods were tested in manufacturing partially fermented tea. These five treatments of

Figure 1. Manual shaping

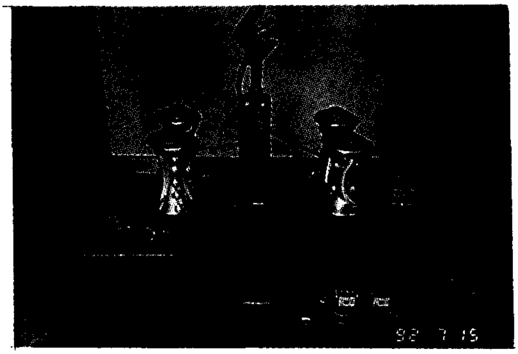

Figure 2. Four-rolling-wheel shaping machine

Figure 3. Vertical-plate shaping machine

shaping methods include the following :

(1) manually, the repanned tea leaves are packed in cloth and shaped as shown in Figure 1;

(2) with a four-rolling-wheel shaping machine, the repanned tea leaves are packed in cloth and placed in the machine, so that the four rolling wheels can move toward the center and shape the tea leaves, as shown in Figure 2 ;

(3) manually with a vertical-plate shaping machine, the repanned tea leaves are packed in cloth and placed between the upper and lower plates, such that the upper plate can move up and down to shape the tea leaves, as shown in Figure 3;

Figure 4. Rotary shaping machine

(4) with four-rolling-wheel and vertical-plate shaping machines, a four-rolling-wheel machine first shapes the tea leaves, then the vertical-plate shaping machine is used for the second stage;

(5) with a rotary shaping machine, the repanned tea leaves are placed into a rotary tank; the tea leaves are shaped when the tank rotates, as shown in Figure 4.

Procedures

(1) Manufacturing partially fermented tea (Oolong tea) following the procedures described in Table 3.

(2) To shape the tea, shaping methods described above were introduced.

(3) Sampling the final tea product of each treatment.

(4) The physical properties of each sample such as bulk density, true density, and breaking force were determined. The quality of each sample was analyzed by means of sensory evaluation.

(5) The data were analyzed according to a SAS ANOVA procedure, and significance differences among treatments were assessed.

Methods to Determine Physical Properties and Quality

(1)Bulk Density

A container (1000 ml) was prepared and filled with tea. Then the container was tapped ten times on both right and left sides. More tea was added if necessary and excess tea was removed by a ruler over the top rim of the container. The mass of tea in the container was determined with an electric digital balance.The bulk density (kg/m^3) of each measurement was calculated by dividing the mass by the volume of the container. Five measurements were taken for each treatment (Peng, 1993) .

(2)True Density

The tea sample was first ground in a blender for 30 s to pass through No.30 sieve. Then the crumbs were poured into a graduated cylinder (100 ml) . The filled cylinder was tapped ten times on both right and left sides to decrease the effects of settling on the results. The volume shown on the graduated cylinder was recorded and the sample was weighed on an electric digital balance. The true density (kg/m^3) was calculated by dividing the mass of the ground sample by the volume recorded from the graduated cylinder. Five measurements were taken for each treatment (Peng, 1993) .

(3)Breaking Force

Twenty samples were sheared using a rheometer with No.31 shear blade. The breaking force was recorded with an X-Y recorder (Peng, 1993) .

(4)Sensory Evaluation

The items of sensory evaluation for tea quality were appearance (20%) , color of infusion (20%) , and aroma and taste (60%) . The total score was 100points; Table 4 shows the conversion of rank to score.

The appearance (20%) of each sample was evaluated according to the shape and firmness of the final product. The color of infusion, aroma and taste were determined according to steps described below. First, a tea smaple (3 g) was measured and placed in a testing cup. Hot water at 98℃ was poured into the cup to 150 ml and retained for 5 min. Then the water was decanted to analyze the color of infusion (20%) and taste (30%) . The expanded tea leaves remaining in the cup were used to analyze the aroma (30%) of the sample. The panels were trained and passed the license test. In this experiment, three samples of each treatment were taken and average scores were determined according to Table 4 (Luan, 1982)

Table 4. Conversion of rank to score for sensory evaluation of tea quality

Rank	Appearance (20%)	color of infusion (20%)	aroma and taste (60%)
A^{++}	20	20	60
A^{+}	19	19	57
A	18	18	54
A^{-}	17	17	51
A^{--}	16	16	48
B^{++}	15	15	45
B^{+}	14	14	42
B	13	13	39
B^{-}	12	12	36
B^{--}	11	11	33
C^{++}	10	10	30
C^{+}	9	9	27
C	8	8	24
C^{-}	7	7	21
C^{--}	6	6	18

RESULTS AND DISCUSSION

The effects of Shaping Methods on Physical Properties of Tea

The physical properties, such as bulk density, true density, and breaking force of the five treatments were calculated and the effects of shaping methods on physical properties are shown in Table 5.

The bulk density differed significantly among the five shaping methods at the 5% level. The shaping method of manual treatment with the vertical-plate shaping machine yielded the greatest bulk density, and the rotary shaping machine provided the smallest bulk density.

For true density, there was no significant difference among those methods which were done manually , with a four-rolling-wheel shaping machine, and with a rotary shaping machine. However, significant differences occurred between these three methods and the method of four-rolling-wheel with vertical-plate shaping machines, between these three methods and the method of manual treatment with vertical-plate shaping machine, and between manual treatment with vertical-plate shaping machine and four-rolling-wheel and vertical-plate shaping machines.

There was no significant difference for the breaking force among four methods other than the method of the rotary shaping machine. Hence the breaking force was significantly different between the method of rotary shaping machine and the other four methods. The rotary shaping machine yielded the smallest bulk density and true denisty, and therefore caused the smallest breaking force.

Effects of Shaping Methosd on Tea Quality

Sensory tasting such as appearance, color of infusion, aroma and taste, and the total scores of these tests are evaluated and shown in Table 6.

Table 5. Effects of shaping methods on physical properties of tea

Shaping methods	Bulk density (kg/m³)	True density (kg/m³)	Bresking force (kg)
1	229.8±3.4[a]	541.8±6.3[c]	7.1±2.5[a]
2	201.5±5.4[d]	537.6±7.3[c]	7.0±2.3[a]
3	262.5±4.0[a]	553.3±5.8[b]	7.0±2.9[a]
4	237.1±2.5[b]	565.0±5.4[a]	7.1±2.2[a]
5	134.8±5.7[e]	538.2±4.7[c]	3.7±1.6[b]

Values with the same superscuipts were not significantly different at the 5% level; the methods were

1: manual shaping,
2: with a four-rolling-wheel shaping machine,
3: manual with a vertical-plate shaping machine,
4: with a four-rolling-wheel and vertical-plate shaping machine, and
5: with a rotary shaping machine.

Partially fermented tea manufactured manually or manually with the vertical-plate shaping machine resulted in the best appearance. Using the four-rolling -wheel shaping machine or the four-rolling-wheel and vertical-plate machine produced the second level of appearance. The rotary shaping machine method yielded the third level of appearance, matching the preceding results shown in Table 5.

The phenomena can be explained in that functioning of the rotary shaping machine differed from the other methods; therefore it caused the smallest bulk and true densities. Then, the smallest bulk desity resulted in the smallest breaking force, and also caused the worst appearance.

For the color of infusion, there was no significant difference among the three treatments such as manual handling, with a four-rolling-wheel and vertical-plate shaping machine, and with a rotary shaping machine. However, significant differences occurred between manual shaping with the vertical-plate shaping machine and the above three treatments, and between the four-rolling-wheel shaping machine and the above three treatments.

Tea manufactured manually yielded the best ar-

Table 6. Effects of shaping methods on tea quality

Shaping methods	Appearance (20%)	Color of infusion (20%)	Aroma and taste (60%)	Total (100%)
1	16.1±0.1[a]	15.0±0.0[b]	41.0±0.5[a]	72.1±0.5[a]
2	14.6±0.1[b]	13.0±0.0[c]	37.3±0.6[c]	64.9±0.6[c]
3	16.1±0.1[a]	16.0±0.0[a]	39.9±0.4[b]	72.0±0.5[a]
4	14.5±0.0[b]	14.8±0.0[b]	38.0±0.6[c]	67.3±0.3[b]
5	14.0±0.0[c]	14.8±0.8[b]	38.4±0.5[c]	67.2±0.5[b]

Values with the same superscripts were not significantly different at the 5% level; the methods were

1: manual shaping,
2: with a four-rolling-wheel shaping machine,
3: manual with a vertical-plate shaping machine,
4: with a four-rolling-wheel and vertical-plate shaping machine, and
5: with a rotary shaping machine.

oma and taste, manually with vertical-plate shaping machine gained the second level of results, and the other methods achieved the third level of results.

As for the results of total sensory evaluation scores, tea products from methods of manual handling or manual handling with a shaping machine provided the best quality, but cost most. Using a rotary shaping machine or a four-rolling-wheel and vertical-plate shpaing machines attained the second level of tea quality, and the four-rolling-wheel shaping machine provided the third level of tea quality. The rotary shaping method cost least among the five methods.

According to results shown in Tables 5 and 6, the rotary shaping machine provided the second level of tea quality although it resulted in worst appearance and physical properties. The shaping method with the rotary shaping machine has potential for further improvement. Therefore, improving the rotary shaping machine to improve appearance and quality would be a reasonable way to decrease the shaping cost and to increase the tea quality.

CONCLUSIONS

According to the our results, the following conclusions result.

(1)The shaping method of rotary machine resulted in the smallest bulk and true densities, and breaking force among all five shaping methods; it also caused the worst tea appearance, but it provided the second level of tea quality and cost least.

(2)Shaping methods of manual handling or manually with a machine resulted in the best tea quality, but were the most costly.

(3)A shaping method using a rotary shaping machine is suggested to be further improved in order to promote the quality of tea and to diminish the cost of production.

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