

Research Article

Study of Airing Way of Fermented Grain in Brewing of Luzhou-flavor Liquor

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Abstract: Effects of different airing way of fermented grains on the physical and chemical indicators, uniformity, of unfermented grain and pits fermentation of Luzhou-flavor liquor were studied in this study. The results indicated that as the way of mechanization airing, the machine airing way absolutely more meets the technology demand on the production of Luzhou-flavor liquor than the airing on-field and airing on-bed. Furthermore, it not only benefits for the stability and uniformity of fermented grains, fermenting, but raises productivity of liquor.

Keywords: Airing way, fermented grain, luzhou-flavor liquor, mechanization, pits fermentation, productivity of liquor

INTRODUCTION

In the 1950s, cooling process of fermented grains was carried out by handwork airing. However, the tech of airing combines ventilating on the ground with that under it in the 1960s. Until the 1980s (Zhang, 2011a), it was accustomed to utilize automatically ventilated airing, no matter on the ground or under it. Then the chill-down equipment that seems like airing bed appeared. What is more, the two techs are still the main methods. Now, through there are large scale automatic research, it has little effect on it. Besides, the mechanization is seldom deeply reported in detail, most of the reports just refer to the history in theory, or state current level of mechanization simply, as well as the comparison with traditional production manner. However, there is no further study on mechanical equipment of the production process. To be glad, there are some research and trial on mechanization in Hetao Corporation in Inner Mongolia (Ren, 2010) and it has a perfect result.

MATERIALS AND METHODS

Airing on-field: Airing on-field is the artificial-oriented half-automatic way of airing, which was widely used in Luzhou-flavor liquor (Zhang, 2011b), some workshops of famous wineries are still using this airing method such as Luzhou, Jiannanchun, etc.

The chill-down method can cool the distilled grains well by ventilator, crane will hang barrel after drawing

water and then pour the distilled grains on a horizontally stainless steel net plate with holes, next, workers would open it by iron harrows and make it well-disturbed and loose on the sheets, with the thickness of approximately 10 cm. After that, click the start button of the ventilator, at the same time turn on the stirring machine every 5-10 min, sometimes it needs workers to stir. Afterwards, it is time to close the ventilator when the temperature drops to that of adding enzyme. It also demands craftsmen scatter fermentation powder and then mix into uniform distribution, finally gather up into wine cellar by accumulators. In some degree, the method applying cranes and accumulators saves certain unnecessary cost of labor, using some machinery instead of manual work. But the production environment is not fundamentally improved, in addition, there were a number of problems, for example, ou went and the ferment grain may be contaminated since it's still stacked in environment of human activities in certain period.

Airing on-bed: Airing on-bed which is widely used in Luzhou-flavor liquor production was typically half-automatic as well. The equipment mainly contains an overall supporting structure, an ordinary gearing, a ventilator, a container taking in fermentation powder, as well as the whole electric motor system. In general, the device is uncomplicated and coarse in design and assembly.

Airing on-bed was also half-automatic. The retort distilled grains are piled in the front of the lowest point

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of the airing on-field. Workers transport the distilled grains to the belt made of bamboo, which is still a labor-consuming task and lasting the whole course of airing-the device starts, the bamboo weaving belt begins to work, ventilator under it at once makes a only saves labor, but makes the environment much more clean, dropping temperature more even. However, the distilled grains are still on pile, the burden of the workers is still heavy and the equipment is not at the high level of mechanization.

Airing on-machine: The integral airing system is made up of feeding-grains machine, airing machine, adding-enzyme machine, controlling system. In structure, it can be divided into two parts: feeding-grains machine, airing machine and the overall dimension is 12300 mm (length) ×2800 mm (width) ×2600 mm (height), the general power is approximate 16 kw.

And the feeding-grains machine consists of an overall supporting structure (length*width*height: 3200×2600×1850 mm), a synchronous gearing with belt (decelerator power: 1.1 kw, the sheet of stain: length*width: 2800×1150 mm), a hopper with the volume of 2.2 m³ (size of the opening: 2500×2500 mm), the airing machine consists of an overall supporting structure (length*width*height: 8500×2800×2500 mm), a synchronous gearing with belt (decelerator power: 1.5 kw, the sheet of stain: length*width: 8000×1200 mm), 6 stirring devices (decelerator total power: 1.65 kw), another stirring device (decelerator power: 0.55 kw), 6 ventilators (total power: 9 kw), 3 rubbish dumps, adding-enzyme device (decelerator power: 0.37 kw).

The barrels are hung by crane to pour the distilled grains into feeding-grains machine and it will perform when everything is fine, start the airing machine while regulating the parameter in great condition until the distilled grains drop on the sheets. As with the process of it, turn on the ventilator and stirring machine as well. The worker turns on the adding-enzyme machine and regulates to appropriate working parameters according to the speed of feeding-grains machine and the airing machine when the distilled grains are under the adding-enzyme machine. Along with the airing machine, the distilled grains drop into stir cage to mix up and then to the hopper which will be lifted by crane into the cellar. The last step of airing was enzyme adding.

RESULTS AND DISCUSSION

Comparison of the stability of unfermented grains on the different airing ways: The physical and

commence, until the airing has finished, the stage of scattering starts, dropping into accumulator with the belt descending, eventually, separate the pile manually. Compare with airing on-field, to some degree, it not

chemical indicators of unfermented grains on the different airing ways were measured and analyzed. The statistic was finished in spring, autumn and winter and the temperature range is 10-25°C (Shen, 2011). Since the temperature is too high, only those below 25°C were calculated. The results are shown in Table 1.

Table 1 showed that the physical and chemical indicators of unfermented grains on the different airing ways meet the technology demand on the production of Luzhou-flavor liquor. The range-ability of the four indicators, i.e., temperature, water, acidity grade and amyllum, of unfermented grains of the airing on-machine workshop is the minimum. The reason is the airing machine is controlled by mechanical parameters instead of the experience of workers. This shows the advantages of stability of airing machine in mechanized production, which leads to the stability of unfermented grains.

Comparison of the uniformity of unfermented grains of the different airing ways: After airing, take temperature measurements and sensory evaluation on unfermented grains of the same retort, the maximum difference in three samples of each index is the measurement criteria of uniformity. The experimental results are shown in Table 2.

It is obviously seen from Table 2 that airing on-field has the biggest difference, but those of airing on-bed and airing on-machine decrease in turn in comparison of the above five indicators, which fully explains that airing on-machine have a significant advantage on uniformity in airing. All distilled grains have been cooled down in the same cool ways, the other two are slightly different due to differences in the way airing manually operated in airing working process, so the airing fermented grains are uniform in all aspects on airing on-machine.

Comparison of the fermentation of pits and the liquor fermentation rate: In order to study of the impact of new equipment on pits fermentation, we did dynamic tracking of pits physical and chemical indicators of the fermentation process, monitoring the pits fermentation and comparing airing on-field and airing on-bed, the experimental results are shown in Table 3 to 5.

Table 1: Physical and chemical indicators of unfermented grain by the different airing ways

Item	Airing on-field	Air on-bed	Airing on-machine
Temp (°C)	19.70 (±4.30)	20.2 (±3.50)	19.50 (±2.70)
Water (%)	58.00 (±1.50)	57.3 (±1.40)	58.80 (±1.30)
Acidity grade (mmol/10 g)	1.55 (±0.19)	1.5 (±0.15)	1.43 (±0.15)
Amyllum (%)	18.10 (±1.90)	18.1 (±1.40)	18.10 (±1.00)

Table 2: The comparison of the uniformity of unfermented grain by the different airing way

Item	Airing on-field	Air on-bed	Airing on-machine
Temp difference (°C)	4.6	1.1	0.8
Water difference (%)	1.3	1.1	0.9
Amylum difference (%)	0.7	0.9	0.5
Acidity grade difference (mmol/10 g)	0.2	0.2	0.1

Table 3: Physical and chemical indicators of the fermentation process of the workshop by the airing on-field

Item	Temp (°C)	Water (%)	Amylum (%)	Reducing sugar (%)	Acidity grade (mmol/g)	Alcoholicity (% vol)
0	17.7	58.3	18.9	-	1.6	-
1	17.8	58.2	15.3	2.0	1.7	0.4
3	18.5	58.7	13.7	1.9	1.8	0.8
6	20.1	59.5	13.6	1.5	2.1	1.3
14	27.5	60.8	12.2	0.8	2.3	2.1
24	30.8	62.3	10.8	0.4	2.5	3.7
37	31.1	62.4	10.1	0.3	2.8	4.0
50	30.7	63.7	9.0	0.2	3.3	4.1

Table 4: Physical and chemical indicators of the fermentation process of the workshop by airing on-bed

Item	Temp (°C)	Water (%)	Amylum (%)	Reducing sugar (%)	Acidity grade (mmol/g)	Alcoholicity (% vol)
0	19.7	58.1	18.2	-	1.5	-
1	19.7	58.4	16.7	1.9	1.6	0.4
3	21.0	58.8	14.6	1.7	1.7	0.6
6	23.4	59.3	13.6	1.4	2.1	1.1
14	29.1	61.9	11.3	0.8	2.4	2.2
24	32.0	63.5	10.8	0.4	2.6	3.4
37	31.7	63.8	10.4	0.2	3.0	4.1
50	30.7	64.9	9.4	0.3	3.7	4.2

Table 5: Physical and chemical indicators of the fermentation process of the workshop by airing on-machine

Item	Temp (°C)	Water (%)	Amylum (%)	Reducing sugar (%)	Acidity grade (mmol/g)	Alcoholicity (% vol)
0	18.8	59.2	17.3	-	1.6	-
1	19.2	59.3	15.3	2.3	1.7	0.6
3	20.1	60.0	13.9	2.1	1.7	0.8
6	24.8	60.4	13.2	1.8	1.8	1.3
14	30.8	62.0	11.3	0.7	1.9	2.6
24	32.4	63.5	10.2	0.4	2.2	4.2
37	31.8	64.0	9.8	0.2	2.7	4.1
50	29.6	64.6	9.2	0.2	3.1	4.3

Table 6: The yield and degustation of liquor by three airing manner

Item	The liquor yield (%)	Results of degustation
Airing on-field	28.47	Fragrant usual, a little grain fragrance, sweet, slightly astringent, aftertaste short
Airing on-bed	28.50	Better grain fragrance, sweet, net, aftertaste usual
Airing on-machine	29.21	Fragrant, with grain fragrance, sweet, slightly astringent, less net, aftertaste short

From Table 3 to 5 we can see that the change of temperature of the fermentation pits is related to the consumption of amyllum and reducing sugar. The rising of the temperature of pits mainly concentrates in 3~14 days. And the temperature rising curves all accord with the change regulation of the fermentation temperature of Luzhou-flavor liquor-rising slowly in early stage, rising steeply in medium stage and falling in later stage. The fermentation of airing on-field is slow and the rapid rising of the temperature begins after 6 days. This may be due to lower initial temperature of pits and the temperature of the top of the pit is only 31.1°C. The rising of the medium fermentation temperature of airing on-bed is not steep, but the rising amplitude of water and acidity of fermented grains is the biggest. Mass production of acid in fermentation is probably caused

by acid producing bacteria. Too much acid would affect the favor of the liquor and reduce the quality of the liquor. The temperature of pits of airing on machine rises slowly in early stage, steeply in medium stage and falls in later stage. This indicates the change of the fermentation temperature is better. The main reason may be due to the initial temperature of the workshop with airing on-machine is suitable and the stability and uniformity of the initial fermented grains are better.

The Table 6 shows that the liquor yield of the workshop with airing on-machine is significantly higher than that of the other two workshops. This indicates the fermentation of the workshop with airing on-machine is good and its liquor quality is improved. The normal fermentation of pits are largely influenced and restrained by the initial conditions. So the workshop

with airing on-machine could ferment better. And the better the fermentation is, the better the liquor is. This can be seen from the results of degustation. And the results of the mechanization workshop are better than the other two workshops and the liquor of it has typical flavor characteristics of Luzhou-flavor liquor.

CONCLUSION

The traditional methods of airing interspersing with mechanized elements are widely used in the production of Luzhou-flavor liquor. It's mainly due to the higher input costs and worse airing effect of airing machine. This article compares the old and new airing ways and fully illustrates that the airing on-machine meets the technology demand on the production of Luzhou-flavor liquor, at the same time it saves labor and raises productivity of liquor.

Under the automated and intelligent background of the fermentation industry, the level of mechanization of solid-state liquor production must be increased as soon as possible. We need to vigorously popularize and raise the useless of new equipment in the production of solid-state liquor. It's urgent to realize the standardization and normalization of airing mechanical equipment manufacture.

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