Effects of the Addition of Several Fatty Acids during Fermentation on the Flavor and Quality of Sorghum Spirits

黃燕君、游銅錫

E-mail: 9300047@mail.dyu.edu.tw

ABSTRACT

Abstract Sorghum Spirits is the main material for Kao-Liang brewing. During the brewing process, spray adequate amount of fatty acid evenly onto the sorghum spirits, it will trigger esterification enzyme reaction. And the acid will react with the generated alcohol and therefore produce ester. Esters is the key aroma component of sorghum spirits. Moreover, the acid will enrich the esters aroma of the alcohol. According to studies, if we were to increase the amount of ethyl caproate of the generated alcohol, and at the same time, to keep its refreshing aromatic characteristic, as well as its flavor harmony by adding hexanoic acid alcohol solution to ferment, adding 5% hexanoic acid alcohol solution to a concentration of 0.8ml/100g fermented alcohol material can obtain a more prospective outcome. On the other hand, with the effect of suppression of enzyme and acidogenic bacteria when adding hexanoic acid during solid state fermentation, it is better to spray acid onto the 7th day Kao-Liang fermented material for the good of etherification. During this period, the amount of enzyme and activity are higher. The purpose of this study is to probe the effect of the twelve acids, Formic acid、Acetic acid、Propionic acid、Butyric acid、Valeric acid、Hexanoic acid、Heptanoic acid 、Octanic acid、Nonanoic acid、Capric acid、Undecylic acid、Lauric acid, which have been diluted to 5% acid alcohol solution using 95% alcohol and prayed onto the a concentration of 0.8ml/100g Kao-Liang fermented material on the 7th day of first fermentation of Kao-Liang. Also, to compare the effect of different acids on the quality of distillated wine and flavor after 1st and 2nd acid spray. The pH of the wine after 1st distillation is between 3.73 to 3.98 and the pH after the 2nd distillation are between 3.98 to 4.23. And the pH of the controlled group (acid spray has not been carried out) is 3.98 and 4.04 relatively for the 1st and 2nd distillation. Therefore, the pH for the 1st acid-sprayed distillated wine tends to be lower, and the wine sampling range of 1st and 2nd distillation is around 60~65%. The production volume of the first distillated wine with Octanic acid wine is the lowest (16.0/100kg Kao-Liang wheat), whereas the production volume of the 2nd distillated wine with Acetic Acid is the highest (22.0L/100 kg Kao-Liang wheat). Comparing the final wine generation, the ones with Formic acid get the least volume (19.70L pure alcohol/100 Kao-Liang wheat), and the ones with Acetic acid reach better production (24.40L pure alcohol/100 Kao-Liang). A sensory analysis of mixed alcohol with different ratio is carried out. The result of the 1st distillated sorghum spirits after the process of acid spray during the 1st fermentation is as follows: Hexanoic acid 5 and Acetic acid 3, both are favored. And for the 2nd distillated wine: Hexanoic acid 5, Acetic acid 4 and Butyric acid 3, are favored. A qualitative and quantitative analysis is done using GC-MSD to analyze the aromatic compound. Two sampling method are implemented, one is to direct inject sample and the other is to use dichloromethane to extract concentrate and then determine the aromatic compound. The results of the injection of various Acid-sprayed sorghum spirits with GC-MSD, are 63 chemical compounds, including 10 acids, 11 alcohols, 5 aldehydes, 30 esters, 2 ketones and 5 other compounds. The aromatic analysis of dichloromethane extracted concentrate are 138 chemical compounds, including 12 acids, 32 alcohols, 12 aldehydes, 54 esters, 7 ketones and 21 other compounds. And the aromatic analysis of direct sampling onto GC-MSD is as follows: Acids compounds are mainly volatile fatty acids, there are abundant Ascetic acid in all samples. It ’ s probably relative to the natural miscellaneous bacteria cultivated wheat germs. Comparing acid remain of the 1st and 2nd distillated wine with propionic acid、butyric acid、valeric acid、hexanoic acid、heptanoic acid、octanic acid、Nonanoic acid, the few remain indicated the adequate addition of acid. However, capric acid、undecylic acid、lauric acid was not present in the relative acid-spray wine. Also, there is relative amount of ethyl present in the 2nd distillated wine, it is possibly because the high boiling points of these acids that are not easily distillated. The key aromatic compound of distillated wine is alcohols compounds. Apart from ethanol, our research institute takes n-propanol、iso-butyl alcohol、iso-amyl alcohol、2,3-butanediol 、2,6-dimethyl1-4-heptanoland n-hexanol as main when producing sorghum spirits. In aldehyde compounds, acetaldehyde、acetal are main. Among ester compounds, Fatty acid, esters has the highest content, especially ethyl lactate which had the sorghum spirits characteristic of solid state fermentation. In ester compounds, ethyl acetate、ethyl lactate、iso-amyl acetate、ethyl caproate、ethyl succinate、ethyl palmitate、ethyl linoleate、ethyl oleate、ethyl stearate are main. The aromatic compounds are higher in the control group with no acid spray, ethyl acetate 40.88%、ethyl lactate 20.18%, it ’ s probably because of the bacterriostasis function of the acids. The key component of ketones is acetion. And that of the other compounds are 2,4,5-trimenthyl1-1,3-dioxolanel. The outcome of wine extracted concentrate after GC-MSD reading tells that part or all high volatile compounds will loss, for example acetic acid、methanol、ethanol、2-butanol n-propanol、iso-butyl alcohol、1-butanol、2,3-butanediol、acetal、acetaldehyde 、ethyl acetate、acetoin and compounds. We can also read the increase volume of compounds like palmitic acid、ethyl lactate

、iso-amyl alcohol、ethyl caproate、ethyl palmitate、ethyl linoleate、ethyl oleate、ethyl stearate because of the extract of concentration. From the above analysis, direct sampling and extract of concentration both have their function. From the chart of total aromatic compounds content, we find adding relative amount of different acids can increase the content of ethyl apparently. And understanding the reaction of adding C1~C12 acids can also reach the contact of organic acids and alcohol to trigger etherification which produces ester. Acid is essential for flavor and ester is impeccable for aroma, both of them can complement one another. Key word：sorghum spirit, esterification enzyme reaction, solid state fermentation, GC-MSD, Formic acid, Acetic acid, Propionic acid, Butyric acid, Valeric acid, Hexanoic acid, Heptanoic acid, Octanic acid, Nonanoic acid, Capric acid, Undecylic acid, Lauric acid

Keywords : sorghum spirit ; esterification enzyme reaction ; solid state fermentation ; GC-MSD ; Acetic acid ; Propionic acid ; Butyric acid ; Hexanoic acid

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