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Preparation and functional properties of maltose ester lactate

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First ethyl lactate was prepared from L-lactic acid and ethanol, with L-lactic acid the conversion rate as an index, the effect on the reaction of the molar ratio, reaction time and amount of catalyst were studied. Then maltose ester lactate was prepared from maltose and L-ethyl lactate, with monoester yield as an index, the effect on the reaction of the molar ratio of maltose and L-ethyl lactate, reaction time and amount of catalyst were then studied. The features of products such as: emulsifying and emulsion stability, oil retention were also studied. The results showed that the optimum conditions for the preparation of ethyl lactate is the molar ratio of L-lactic acid and ethanol 2:1, a reaction time of 1h, with the catalyst accounting for 2.5% of the lactic acid amount. The optimum conditions for the preparation of maltose ester lactate is a molar ratio of maltose and L-ethyl lactate of 1:2, areaction time of 6h and a catalyst amount of 8%.

Keywords:*Emulsifier, maltose ester lactate, L-lactic acid, maltose

INTRODUCTION

Since China's accession to the WTO, there are a variety of products that should conform with the international quality standards. In order to satisfy the people's quality requirements and avoid foreign technical barriers to exports, the state requires to implement the international standards for a variety of products. Thus, in the food industry, food emulsifier selection and use heeding the constraints.

Currently the commonly used food emulsifier glycerin fatty acid ester [1], about 53% of the total; soy lecithin and derivatives, accounting for about 20% of sucrose fatty acid esters and sorbitan fatty acid esters Rio 10%, about 6% of propylene glycol fatty acid ester. In addition, xylitol anhydride monostearate, polyoxyethylene stearate and xylitol anhydride and the like. However, in recent years many experiments showed that these emulsifiers are not ideal.

Lately, in bread production, in order to slow down the aging of bread, reduce the gluten strength and improve the machinability of the dough, in orderto improve the quality of bread, make color bread, improve smell, taste, shape and better meet the needs of the consumers around the world, bread improvers have been widely introduced.

Bakery products impatiently stored, during the storage process will be acquire mildew and begin to age. In the large-scale production and sales of bread today, especially as the most serious problem is the aging of bread: the bread stored will be a little hard on the skin, the flavor is lost and other changes also occur. According to the statistics, in 1990 due to the aging of bread the United States losses reached $ 1 billion. As early as a century ago, the people started to seek solutions, foreign studied developed rapidly in this area. Thus, the French manufactured a bread with a shelf life of up to 92 days; the US military can allegedly increase bread shelf life to three years. Compared with foreign countries, China's bread industry, still experiences significant gaps, aging bread is a serious problem in China's bread industry, generally bread ages in three to five days, due to the short shelf life and intolerant storage, but also bread staling as a constraint to the development of China as an important reason for the bread industry, therefore, how to slow down the aging of bread, our bread industry needs to solve this major issue. Meanwhile, in the baking industry, there are similar problems, to solve this problem, we will promote the development of the baking industry.

In the production and use of the world's food emulsifier class of about 65 [2], the United Nations developed a standard total of 34 species, 58 kinds in the United States, the world's total annual demand is equivalent to about 800 million US dollars, 250,000 tons more than for consumption. In recent years, with the rapid rise of the food industry, emulsifier output ranked first in industrial output, the food additives production and research also has been considerably developed. The food emulsifier is the most important food additive, it not only has the typical surface activity in order to maintain a stable food emulsion state, but also exhibits a number of special features and thus plays an important role in the food industry. More widely applied since 1994 in our country are 30 kinds of food emulsifier varieties that are approved for use.

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This practice started late, but developed rapidlyand there are several varieties arrived at following Research and Development. At present, China is capable of producing glycerides, sucrose esters, Span and Tween, propylene glycol, soy lecithin, nearly 30 species, consumption is expected to reach 15,000 ~ 20,000 tons.

L-lactic acid, which is a lactic acid. Lactic acid, its formula is CH_3CH (OH) COOH, the scientific name a- hydroxy acid, the molecule contains an asymmetric carbon atom and is therefore optically active (L-, D- and racemic). There are three configurations of lactic acid, L- lactic acid is one kind, one kind of the D- lactic acid, there is a known DL- lactic acid. Lactic acid is an important organic acid, a raw material to it as an additive, preservatives, disinfectants and regulating agents play an important role in the brewing, food, cosmetics, pharmaceuticals, packaging, tobacco and other industries. The study found that the human body is only able to metabolize L- lactic acid, so that only L- lactic acid can be absorbed by the body and the microorganisms without any toxic effects, if too much D- or DL- lactic acid is ingested it will cause the blood rich in D - lactic acid, DL- lactic acid to cause fatigue, metabolic disorders and even poisoning. Therefore, it was suggested to the World Health Organization that D- and DL- lactic acid should not be used in children's foods. Thus, in the food industry L- lactic acid gradually substituted D-Lactic acid as an inevitable trend. Currently L-lactic acid production has just begun, with about 5% of the total production of lactic acid, as production increases, the application will also be expanded.

Starch sugar esters in domestic development is still in its infancy [3], yet we went to further research and develop these. Starch sugar (jelly) as a raw material for ester products, its superior performance and functionality with glycerol esters and such products. I chose maltose and ethyl lactate as the raw material, synthesis of maltose lactate ingestion of the human body, can be hydrolyzed to lactic acid and maltose (broken down into two glucose molecules) that can regulate the body's physiological function, with broad development prospects.

Maltose ester lactate is an important class of thickening with excellent emulsifying properties [4], biodegradation, security, a good surfectant and starch sugar esters. It not only has monoglyceride, sucrose ester emulsification, but also a thickening effect. Especially the emulsion stability of its unique properties, can be used to replace animal and plant gum. It also has more of a role in regulating the body's physiological function, so it was developed to meet the requirements of the natural, nutritious, low-calorie, multi-functional role people expect. Maltose lactate as the food of industry, the pharmaceutical industry, the cosmetics industry, dispersants, emulsifiers, stabilizers, suspending agents, thickening agents, clouding agents, binders and suds boosters and detergents.The development of maltose lactate can be added as the emulsifier series to a new class of ester products, enriched emulsifier varieties, it has good prospects as a class of products.

L- lactic acid and maltose are good for the health, so these are used as a raw material, this paper describes the process conditions of maltose lactate, providinga theoretical and practical basis for the future development of starch sugar esters.

The synthesis process of maltose lactate is reported rarely and only at the research stage, we have not formed references to sucrose fatty acid ester (SE) and synthetic maltose lactic acid ester transesterification. Transesterification is divided into a solvent and its solvent-free, synthesis experiments were carried out by two methods, the solvent-free starting material can not form a homogenous system, the reaction hardly proceeds, we used selected solvents. The solvents are: methanol, propylene glycol and ethanol. Propylene glycol as a solvent after the reaction takes place is difficult to remove, but maltose was not dissolved in ethanol, so methanol was used as a solvent.

MATERIALS AND METHODS

Synthesis of L- ethyl lactate

Principle of the method

Esterification of L-lactic acid and ethanol in solid ferric chloride as a catalyst may be the mechanism of the process as follows[5] (Fig.1):

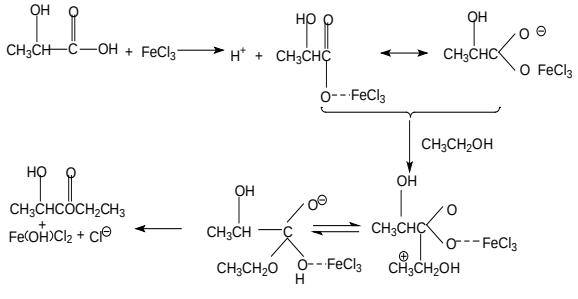

Fig. 1. Synthesis of L-ethyl lactate.

Synthetic methods

A reflux condenser, a thermometer and an electric mixer were installed on a three-necked flak.

First, three-necked flask were added in 100ml of solid iron chloride, L-lactic acid, ethanol, reflux

condenser installed, start the electric mixer stir, and heat up, reflux esterification, and sampled for lactate conversion rate, when a total reflux after a certain time, to join the band agent, installed water separator and reflux condenser, heating was continued reaction, esterification reaction, the esterification side edge excess water separated from the oil-water separator, maintaining evaporated the water carrier and raw materials continue to reflux until no more water separator to separate water droplets when discharged trap layer of water and oil, and heating was continued to maintain boiling, quickly evaporated ethyl acetate, ethanol, mixed with oil recycling to save, and then vacuum distillation to collect the product fractions, analytical testing, the conversion rate calculated by a vacuum pump.

Synthesis of maltose ester lactate

Principle of method

Maltose and ethyl lactate in the catalytic composite catalyst of anhydrous K_2CO_3 and PEG-400 transesterification reaction mechanism is as follows(Fig.2):

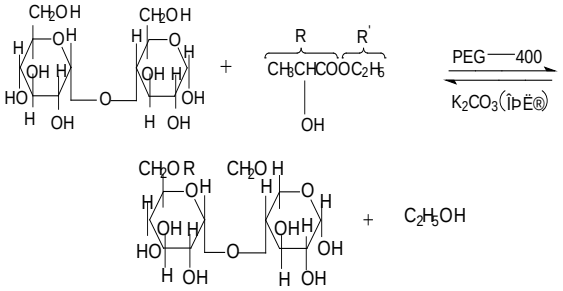

Fig. 2. Synthesis of maltose ester lactate

Synthetic methods

In a three-necked 100mL flask, adding a certain amount of maltose, homemade L-lactate, PEG-400, and a basic catalyst is K_2CO_3 thoroughly mixed together, a high speed stirring, heating. The reaction 6-8 hours, every half hour during the reaction stopper is removed, releasing the resulting ethanol. After completion of the reaction, a basic catalyst is added and tartaric anhydrous K_2CO_3, pH value reached about 7, the system not only precipitated the crude product as a pale yellow viscous liquid maltose lactate, the yield was calculated.

Analysis method

NaOH standard solution calibration

NaOH standard solution preparation

The solution is 1000mL0.1mol/NaOH in a small beaker on the scales quickly weighing 4g of NaOH, dissolved in 100mL of water and transferred to a 1000mL volumetric flask, then washed with pure water in a beaker three times with 50ml transferred to the capacity of the flask and then diluted to 1000mL, stoppered with a stopper, shaked and posted.

NaOH standard solution calibration

The referencereagent of 0.4-0.5g wasaccurately weighed with anelectronic balance then 250mL of potassium hydrogen phthalate($KHC_8H_4O_4$) was added in a conical flask and dissolved in 20-30mL of distilled water adding 1-2 drops of phenolphthalein indicator to the NaOH solution titrated to a solutionprepared from a colorless to reddish appearence, it does not fade for half a minute. Calculate the molar concentration of the NaOH standard solution.

$$C_{NaOH} = \frac{m_{KHC_8H_4O_4} \times 10^3}{M_{KHC_8H_4O_4} \times V_{NaOH}}$$

Wherein:

C_{NaOH} -For calibration of the concentration of NaOH solution（mol/l）

$M_{KHC_8H_4O_4}$-$KHC_8H_4O_4$ molar mass（g/mol）

$m_{KHC_8H_4O_4}$ - Mass of $KHC_8H_4O_4$（g）

V_{NaOH} -For calibration of the volume of NaOH solution consumed during titration（ml）

Determination of the L- lactic acid content

Determination of the L- lactic acid density

Dependent on the quality and volume proportional to the pipette the L-lactic acid is 5mL, in the electronic balance the quality is fine, with three sets of parallelexperiments, taking the average in accordance with theformula:

Density=Mass / Volume

Determination of L - lactic acid content (acid-base neutralization titration method)

Taking 5mL of L-lactic acid,this is transferred into a 50mL volumetric flask with a constant volume and shaken. A volumetric flask with 2mL of L- lactic acid is kept in the conical flask with 1-2 drops of phenolphthalein added, the formulated NaOH standard solution after titration appears colorless to reddish and does not fade for half a minute. Write down the number for the volume of NaOH consumed, the three sets of parallel experiments were averaged.

L- lactic acid content(%)=
Mass of L- lactic acid / Mass of sample

Determination of the L - ethyl lactate acid value

The acid value is: 1g sample and the number of milligrams of free acid is required for KOH[6].

A 1mL amount of the system solution is placed in a pipette then into a Erlenmeyer flask, weighed on an electronic scale and adding to 10mL of distilled water, shaken, dropping 1-2 drops of the cresol red indicator into a standard KOH solution (configuration with NaOH) titrated to a purple color, milli-liters of the KOH solution are consumed. At the same time a blank test is carried out under the same conditions.

Calculated according to the formula:

The acid value is (mg KOH/g)=N×V×56.1/W

Wherein:

V- consumption volume of NAOH solution(ml)

N-Molar concentration of the KOH solution(mol/l)

W- Weight of the sample(g)

56.1- Molar mass of potassium hydroxide

Determination of L-lactic acid conversion rate

Conversion rate(%)= (Total acid number of feedstock - Total acid number of products) / Total acid number of feedstock ×100%

Determination of the maltose ester lactate yield

Yield(%)=Actual yield / Theoretical yield×100%

Determination of the maltose ester lactate features

Oil retention measurement method

Accurately weigh 0.8g of maltose lactate dispersed in 25mL of oil spin at 5000r / min homogeneously for 2min, keep still for 15min, then centrifuge at 500r / min for 15min, afterwards discard the supernatant, access the precipitation weight, while molecular distilled monoglycerides control the experiments, according to the formula[7]:

Hold oil yield(%)=Precipitation mass / Sample mass×100%

Determination of the emulsification and emulsion stability

The lactate 1.2g maltose dissolved in 50mL of distilled water is prepared at a certain concentration of the liquid with 50mL of soybean oil added at a speed of 10000r/min homogeniously dispersed for 2min, divided into 2 equal parts, transferred to a 50mL centrifuge tube and centrifuged at 1500r / min for 10 minutes, at the same time completing a control experiment with monoglycerides, calculated according to the height of the emulsion layer and emulsification as follows:

Emulsification(%) =
Height of emulsion layer /Total height ×100%

A scale load in a 50mL tube is placed in a water bath at 50˚C for 30min successively measuring the volume of the emulsion at every 2.5h. At the same time a single ester is utilized in a controled experiment.

The emulsion stability is calculated as follows:

Emulsion stability(%)=
Final volume of the emulsion / Initial volume of the emulsion ×100%

Structural Identification of the product

Removable liquid absorption cell method

The liquid perfusion in a fixed thickness sealed liquid pool or into a removable liquid pool, into the optical path, the whole scan for the determination.

Solid compression method

Weigh the dry solid sample 1 ~ 2mg and 200mg bromine potassium powder in the agate mortar, in the infrared light grinding evenly, pour into the tablet mold in the shop, put the tongue, put the mold on the hydraulic machine and connect Vacuum system, the first pumping 5min, to remove the mixed in the powder of moisture and air, and then pumping the side pressure to 8t, to maintain 5min, remove the vacuum. The mold rotation 1800, and then pressure to 8t, to maintain 2 ~ 3min, remove the mold. With the help of the "sampler", use a hydraulic press to carefully remove the tongue, in the middle of the upper and lower tongue to get a diameter of 1cm, thickness of 0.8mm sheet, put it on the sample box on the back. Then, 200 mg of potassium bromide powder was ground under the same conditions to make a blank potassium bromide sheet and placed on a reference frame. The prepared film is placed on the corresponding optical path of the infrared spectrophotometer, select the appropriate scanning speed, from 4000 ~ 400cm^{-1} full scan, drawing the infrared spectrum of the sample. The infrared measurement method of the product is the same as above[8].

RESULTS AND DISCUSSION

Determination of the optimum process conditions for the synthesis of ethyl lactate

Process: raw material (catalyst) → esterification (the reaction was kept boiling) water removal → detected→ finished product

Determination of the optimum L- lactic acid and ethanol molar ratio

The fixed reaction temperature is 85 ˚C, the amount of catalyst was 2%, the reaction time is 1h, to change the L- lactic acid and ethanol molar ratios of 1: 1, 1: 1.5,1: 1.8,1: 2,1: 2.5, The conversion rate results are shown in Fig. 3 determined after the synthesis of L- lactic acid

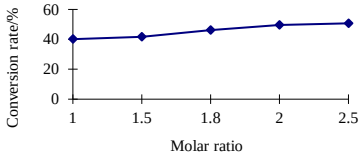

Fig. 3. Effect of the L- lactic acid and ethanol molar ratio on the L- lactic acid conversion rate.

Fig.3. shows that the process parameters for the reaction temperature of 85˚C, the amount of catalyst was 2%, the reaction time is under 1h, the conversion of ethyl lactate is mainly affected by the molar ratio of the L- lactic acid and ethanol, the molar ratio is small, the L- lactic acid conversion is low, with an increase of the molar ratio, the L- lactic acid conversion rate also increases, but the molar ratio is more than 1: 2 later, the L- lactic acid conversion rate does not improve up to a 1 molar ratio of the L- lactic acid and an ethanol ratio of 2 is more appropriate.

Determination of the optimal amount of catalyst

The L-lactic acid and ethanol are in a molar ratio of 1: 2, the reaction time was 1h, the reaction temperature is under 85˚C, changing the amount of catalyst, the synthesis of L- lactate, measured the amount of catalyst used in amountsfor 0.5% of L- lactic acid, at a 1%, 1.5%, 2%, 2.5% level of conversion of the L- lactic acid, the results are shown in Fig.4.

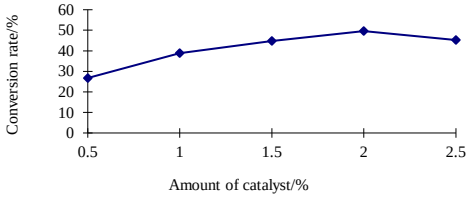

Fig. 4. Effect of the amount of catalyst on the L- lactic acid conversion rate.

The catalyst is generally added to increase the reaction rate and can be seen from Fig.4, it increases with the amount of catalyst, the L- lactic acid conversion rate gradually increased, but when the catalyst amount used is greater than 2%, the L- lactic acid conversion rate is reduced, the L- lactate synthesis catalyst is about 2%in amount.

Determination of the optimum reaction time

In a molar ratio of L- lactic acid to ethanol is 1: 2, the reaction temperature is 85˚C, the amount of catalyst is for the next 2%, the reaction time was changed to 0.5h, 1h, 1.5h, 2h, 2.5h, measuring the L- lactic acid conversion rate, the results are shown in Fig.5.

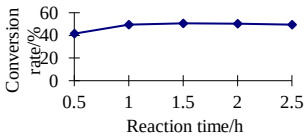

Fig. 5. Effect of the reaction time on the L- lactic acid conversion rate.

Fig.5 shows that, the L- lactic acid conversion rate increases with time, but the conversion rate is not 1h after significant changes in the conversion rate decrease after 2h, a reaction time of 1h is appropriate.

The reaction time is complete and does not have a great influence on the esterification reaction carried out under the same conditions, the reaction time is too long and will lead to reduction of the conversion of L-lactic acid, but also to a deep color of the product, affecting the quality of the product, the appropriate reaction time is 1h.

Identification of the L- ethyl lactate structure

As observed in Fig.6 and Fig.7 the peaks of the L- lactate structures are identified, indicating that this substance is L-ethyl lactate.

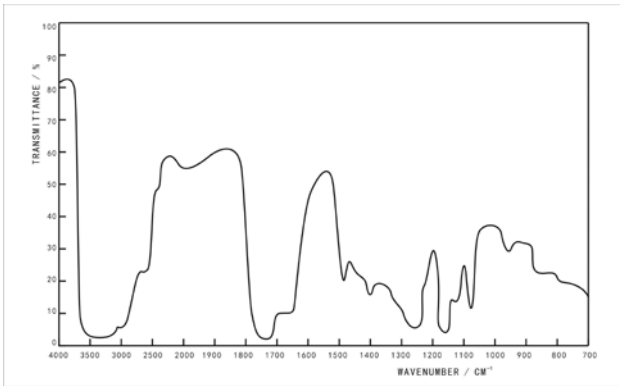

Fig. 6. The L- lactic acid infrared spectrum.

Shown in Fig.6 is the L-lactic acid feedstock infrared spectrum and in Fig.7 the product L-lactate IR spectra for comparison, the product spectrum generatesa methylene (2925cm^{-1}) absorption peak

and a carbonyl peak (1740cm^{-1}) for the ester carbonyl peak, which consists of the carbonyl starting material (1725cm^{-1}), a number moving to a longer wavelength in the direction provenby the reactant converted to the ester product yielding the desired product. (Ethyl lactate and consistent with the spectrum of the standard products).

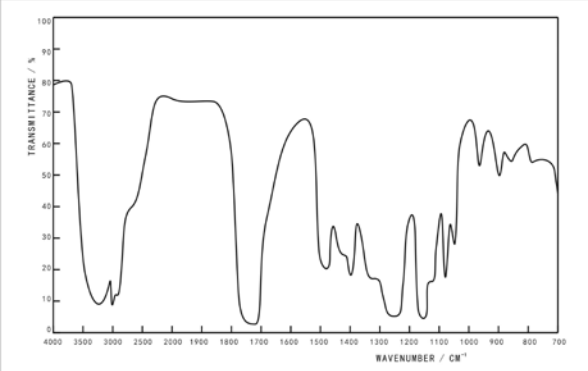

Fig. 7. The L- ethyl lactate infrared spectrum.

Determination of the optimum maltose ester lactate synthesis conditions

Process: raw material (catalyst) → transesterification → neutralization → still → detected → finished.

Determination of the optimum maltose and ethyl lactate molar ratio

In the synthesis of ethyl lactate the maltose reaction temperature is 60 ˚C, the amount of catalyst is 8%, the reaction time was 6h, the change of maltose, the molar ratio of the ethyl lactate and ethyl lactate yields after synthesis were measured in th molar ratios of maltose and ethyl lactate of 1: 1,1: 1.5,1: 2,1: 2.5, the results are shown in Fig.8.

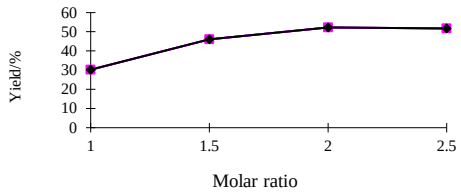

Fig. 8. Effect of the maltose and L-ethyllactate molar ratio on yield.

Fig.8 shows that the reaction temperature is 60 ˚C, the amount of catalyst is 8%, the reaction time is 6h and the conditionsyielding maltose are mainly affected by the lactate and ethyl lactate molar ratio of the maltose impact molar ratio which is small, having a maltose low yield of the lactic ester, givenan increase of the molar ratio, the maltose yield of the lactic ester is increased, but a molar ratio of more than 1: 2 is registered later, the yield then declins, thus a mole of the maltose ethyl lactate of 2 is more appropriate:1is a control ratio.

Determination of the optimum reaction time

The maltose and ethyl lactate molar ratio is 1: 2, the reaction temperature is 60 ˚C, the catalyst dosage is 8% of the synthesised maltose lactate. Synthesis under the above conditions remains unchanged, the reaction times were 5h, 6h, 7h, 8h, for the maltose lactate yields measured, the results are shown in Fig.9.

Shown in Fig.9 are the maltose lactic acid ester synthesis reaction time increases, the yield is not increased, but thereaction timedecreased, the product will become darker in color, a reaction time maintained at around 6h is favorable.

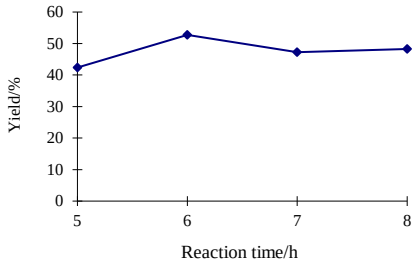

Fig. 9. Effect of the reaction time on the yield.

Determination of the optimum amount of catalyst

The Maltose and ethyl lactate molar ratio is 1: 2, the reaction temperature is 60 ˚C, the reaction time is 6h, the conditions change the amount of the catalyst and maltose lactate synthesized, respectively, the amounts of L- lactate catalyst are 6 %, 8%, 10%, 12% forthe measured maltose yield of the lactic ester, the results shown in Fig.10.

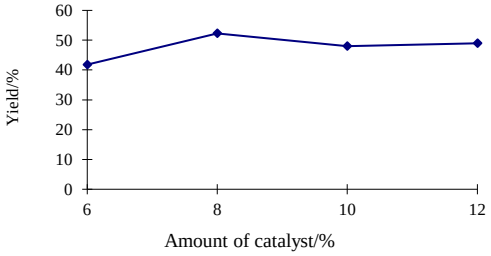

Fig. 10. Effect of the amount of catalyst on yield.

The catalyst added may generally increase the reaction rate of the reaction in the positive direction of the reaction, the excess catalyst will also affect the progress of the reaction and can be seen from Fig.10, it increases with the amount of catalyst, when the catalyst amount exceeds 8%, the maltose yield of the lactate decreased and the additional catalyst causes the product color to deepen,

affecting the quality of the product, such that the appropriate amount of maltose lactate catalyst synthesized is 8% or less.

Effect of the reaction temperature on the synthesis of maltose ester lactate

The temperature requirements for the synthesis of Maltose lactate are very strict, the reaction temperature in the inquiry follow the test:

The maltose and ethyl lactate molar ratio was 1: 2, the reaction time was 6h, the catalyst amount was 8%, the reaction temperature was set at 50 ˚C, the results of a two-phase reaction system, the raw materials were not dissolved into the solvent, resulting in a yield of less than 10%.

Under the condition of maltose and ethyl lactate molar ratio of 1: 2, reaction time of 6h, catalyst dosage of 8%, the reaction temperature is set at 70 ℃, the temperature is too high, resulting in maltose discoloration, the product color is extremely deep, seriously affecting the quality of the product.

Because of these two reasons, the choice of the temperature range is very small, at around 60 ˚Cthe yield did not change much, so the reaction temperature was set at 60 ˚C.

Structural identification of the maltose ester lactate

From the peaks in Fig.11 and Fig.12 the structure of maltose lactate was identified, indicating that this substance is maltose ester lactate.

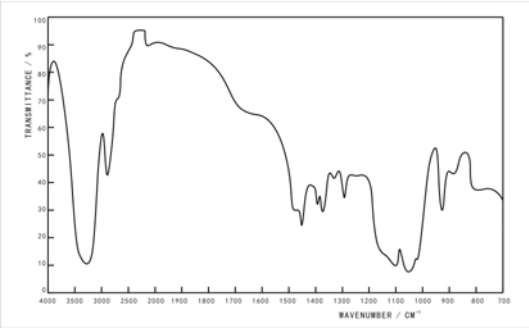

Fig. 11. Maltose infrared spectrum.

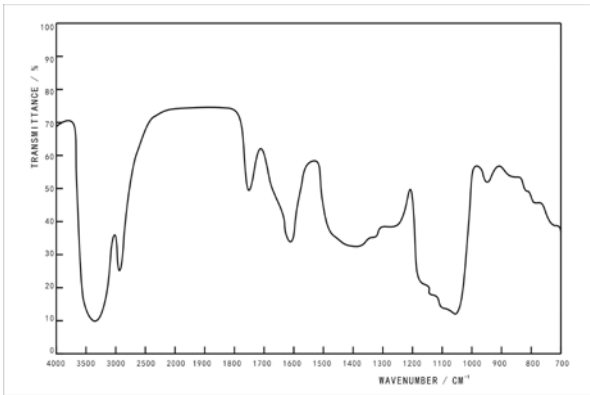

Fig. 12. Maltose ester lactate infrared spectrum.

Fig.11 and Fig.12 present synthesized raw product maltose and maltose lactate apparent from the comparison between the two spectra, the spectrum of the product, the starting material maltose plurality ester carbonyl peak (1740cm^{-1}) and (1580cm^{-1}) of absorption peaks. Very weak carbonyl group (3450cm^{-1}) ester overtone peaks were covered by hydroxy, the reaction proved that the product converted to maltose lactate, the desired product.

Features of maltose ester lactate

Emulsification and emulsion stability of Maltose ester lactate

Emulsifying refers to the lactate maltose binding properties of the oil-water emulsion, the emulsion stability refers to the oil-water emulsion formed together with the ability to maintain stability. Maltose monoglycerides and lactate were measured given emulsification and emulsion stability at the same temperature, the same concentration, as measured and presented in Table 1.

Table 1. Comparison of emulsification and emulsion stability.

Species	Emulsification /%	Emulsion stability/%				
		0.5h	1.0h	1.5h	2.0h	2.5h
Maltose ester lactate	55.00	53.09	53.09	51.22	48.72	48.71
Monoglycerides	40.00	39.14	34.15	32.75	30.89	27.14

Table 1 shows, that maltose lactate has emulsification and emulsion stability, compared with monoglycerides, its emulsifying properties and emulsion stability is greater than for monoglycerides and lactic acid esters, the description of the experiments render emulsification and emulsion stability as standard.

Oil retention of maltose ester lactate

Oil retention refers to the ability to maintain an oil emulsifier, the results in Table 2 present the measured monoglycerides and lactate maltose only holding oil.

Table 2 shows that, compared with monoglycerides, lactic acid ester oil retention by maltose is greater than for monoglycerides,

indicating good oil retention by maltose lactate is desirable.

Table 2. Comparison of oil retention.

Name	Maltose ester lactate	Monoglycerides
Oil retention/%	281.25	187.50

In summary, the laboratory synthesis of maltose lactate in emulsifying, emulsifying stability, oil holdings are similar to monoglycerides or greater than monoglycerides, maltose lactate ester to prove the functional characteristics of the basic meet the requirements, good performance.

CONCLUISIONS

With L-lactic acid and ethanol for the synthesis of L- lactate, the single factor experiment to determine the optimum conditions for the synthesis of ethyl lactate are: a molar ratio of the L- lactic acid and ethanol of 2: 1, a reaction time of 1h, the catalyst accounts for 2% of the L- lactic acid content. While its structure was identified by infrared spectroscopy.

The maltose-step synthesis of L- lactate was synthesized from maltose lactate, through a single factor experiment to determine the optimum conditions for maltose lactate: with a maltose and acetic acid L- ester molar ratio of 1: 2, the reaction time is 6h, the catalyst amount is 8%. While its structure was identified by infrared spectroscopy.

The synthesis of maltose lactate features: emulsifying, emulsion stability, oil retention measured simultaneously using the molecular distillation of monoglycerides as a control experiment. The results showed that the functional properties of maltose lactate are greater than or equal to those of the monoglycerides.

This experiment proves that the project toprepare maltose lactate either by feature or by practical application of the emulsifiers is basically in line with the requirements of a good performance of the emulsifier. The results will be further applied to maltose lactate to provide basic data.

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ПОЛУЧАВАНЕ И ФУНКЦИОНАЛНИ СВОЙСТВА НА МАЛТОЗО-ЛАКТАТЕН ЕСТЕР

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(Резюме)

Най-напред се получава етил-лактат от L-млечна киселина и етанол с показател за степента на превръщане, при различни моларни отношения, времена за реакция и количества катализатор. След това малтозо-лактатът се получава от малтоза и L-етил-лактат с показател добива на моноестер. Изследвани са ефекта на времето за реакция, моларното отношение на малтозата и етиловия естер и количеството катализатор. Свойствата на продуктите (емулгиране и стабилност на емулсията, задържането на масло). Резултатите показват че оптималните условия за получаването на етил-лактат са моларно отношение L-млечна киселина и етанол 2:1, време за реакция от 1 час и катализатор 2.5% от количеството на млечната киселина. Оптималните условия за получаването на малтозо-лактатния естер са моларно отношение на малтоза към етилов естер 1:2, време за реакция 6 часа, а количество на катализатора от 8%.