PRESERVATION OF *TEMPOYAK*

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Abstract

This research project is to determine the effect of High-Pressure Processing (HPP) treatment process and the effects of natural and synthetic additives in the fermentation of *tempoyak.* Quality changes including overall sensory analysis, were monitored for every 3 days of testing for a total 21 testing days. In order to pass the overall sensory evaluation, a set of *tempoyak* samples must pass a minimum of 6 points on a 9-points scale by at least 15 panelists. 0.1g of each additive are added to every 10g of *tempoyak* and compared to standard, stored at 4^{o}C and 25^{o}C (ambient temperature). Pressure ranging from 300 and 600 MPa is used which is expected that the shelf life of *tempoyak* could be of at least 5-6 months and up till 1 year. chromameter test shows that the colour of the samples changed from the initial colour of *tempoyak* that is light yellow in colour. The additives that was chosen are rosemary and turmeric (natural), butylated hydroxytoluene (BHT) and Vitamin C (synthetic). After 21 days, the additives affect the colour of the *tempoyak* in different ways with the biggest change in coloration are Vitamin C and BHT. *Tempoyak* samples under 4^{o}C gives the best result when it comes to coloration, smell and taste. This spectrum range was the highest in all the samples because *tempoyak* is a fermentation product that shows a significant carboxylic and alcohol content, due to the formation of lactic acid (spectrum absorption value of 2500-3300 cm^{-1}. Some of the panellists prefer rosemary and turmeric due to the bitterness they add to the flavour, making the overall sense of tasting better. The coloration also plays major role as it gives certain idea on how the sample are expected to taste which is called as flavor perception.

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1.0 Introduction

Tempoyak, a Malaysian condiment made from bad or spoiled fruit called Durian through fermentation process is one of the most popular food and proven to have many health benefits. this research project will focus on only one type of Durian which is *Durio Zibethinus*, This is to ensure consistency in the results obtained from the experiment; high pressure processing treatment and the addition of additives towards the shelf life longevity of *tempoyak* . This research project is to determine the effect of High-Pressure Processing (HPP) and the effects of additives in the fermentation of *tempoyak* when stored at 27^{o}C. The ecosystem that occurs in molecular level in food is not static. Due to changes in the surroundings and the shifting of the environment's parameters such as temperature, pressure, light intensity, pH changes, etcetera cause stress reactions on the dynamics of growth and biochemical activity of the bacterias present in the food. The majority of the bacteria present in *Tempoyak* belongs to the group of *Lactobacillus sp*., mainly *Lactobacillus plantarum* group. They are known as the Lactic Acid Bacteria which are responsible in the prolongation of the shelf life of most fruit fermentation which in this case is *Tempoyak.* there are different types of LAB present at different stages of fermentation process of *tempoyak* . The few primary types of LAB that exist in *tempoyak* are LAB (8.88-10.42 log CFU/g) being *Lactobacillus plantarum* and *Fructobacillus durionis* as the dominant ones. HPP does not require the act of heat treatment, subjected at high hydrostatic pressure usually at or above 100MPa.

HPP is the application of even and uniform exposure of ultra-high pressures from all sides to the product within a very short time, usually in a few minutes. This method has proven to cause very little to no damage to the food or shows alteration in its physical changes as long as the treated food product does not have an empty space within them. During the pressurization process, almost all the microorganisms are being reduced and proteins could denature, without affecting the molecular bonds of the food. Bacteria under high pressure could have its internals destroyed,

thus rendering it to be inactivated. This in turn will make the food considerably have a longer life span and even provide an improvement to the desired characteristics of the food product. HPP are able to become beneficial in fermentation process as during fermentation, there will be a series of chemical reactions occur within the food environment that may cause the destruction of vitamins or changes to the flavor to be reduced[1].

2.0 Methodology

2.1 Material

The materials used in this research is *tempoyak* sample, turmeric and rosemary oil, BHA and BHT. Equipment used include chromameter to determine the colour, FTIR equipment to determine polymeric, organic and inorganic materials that is found in the sample.

2.2 Methods

10g of *tempoyak* samples is used in the study of each parameters.

A. *Fourier Transform Infrared (FTIR) Testing*

The equipment that is in used for spectrometry testing is the Perkin Elmer/Spectrum One FTIR.It is an analytical technique used to identify polymeric, organic and inorganic materials that is found in the sample. Key in the information required such as the range of 370-7800 cm^{-1}. The best resolution chosen is 0.5 cm^{-1}. the computer in which a dedicated software for the testing is installed is turned on. Click on the background and it will appear "Ready for scan sample". On the instrument, click "Scan" and the box will appear. Key in the information required such as the range of 370-7800 cm^{-1}. The best resolution chosen is 0.5 cm^{-1}. The top plate of the instrument is cleaned with acetone. Since *tempoyak* is a has a thick, paste-like texture, it is considered as solid. A scoop of the *tempoyak* sample is inserted into a hole and is purged. It is important to note not to purge more than 60. The sample is then read to scan. Once the procedure has been ran, the top plate is cleaned again with acetone. On the computer, click on "edit" and copy the result into Microsoft Excel. Repeat the steps with other samples and after using the instrument, click on "exit" to log out from the program.

B. *Chromameter*

The chromameter is Konica Minolta CR-400. The chromameter is used to monitor colour quality based on the colour spaces data. The colour of the *tempoyak* is measured every 3 days for a total of 21 days to determine the colour change in respect to time. The color space of L*a*b* is selected. Before testing the sample, white calibration should be done under the same temperature conditions as measurement by placing the measuring head vertically above the middle of the white calibration plate. The measurement button is pressed after making sure the ready lamp is ON. The calibration should be completed after the lamp flashes 3 times. Now, the measuring head is placed vertically above the specimen until it touches the specimen and the measurement button is pressed to obtain the experimental data.

C. *Sensory Analysis*

The overall sensory analysis was done using the hedonic 9-point hedonic scale. 15 panellists consisted of students from Univerisiti Teknologi MARA (UiTM) Shah Alam and family members. The panellists are of their own willingness and has made to sign a declaration of consent prior to taking part in the experiment. The depiction must include its appearance, odour, flavor, taste and texture (i.e. the sensation of chewing).

3.0 Results and discussion

3.1 FTIR analysis

These are the presentation of data specifically on the O-H group (stretching). The graphs show the absorption value in between 2500-3300 cm^{-1} that represents compound class of carboxylic acid. This spectrum range was the highest in all of the samples because *tempoyak* is a fermentation product that shows a significant carboxylic and alcohol content, due to the formation of lactic acid.

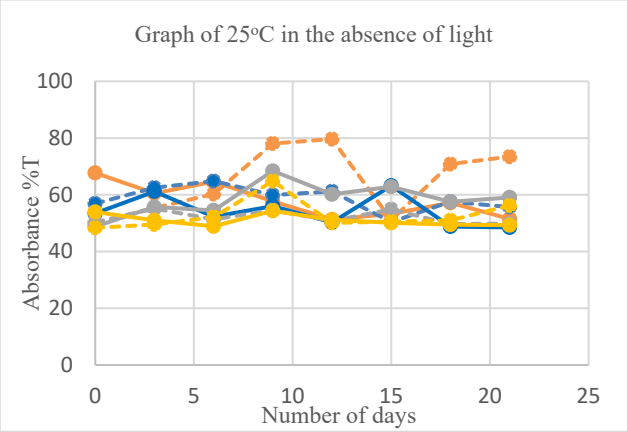


Fig. 1 (i): Graph of absorbance of *tempoyak* samples at 25°C in the absence of light.

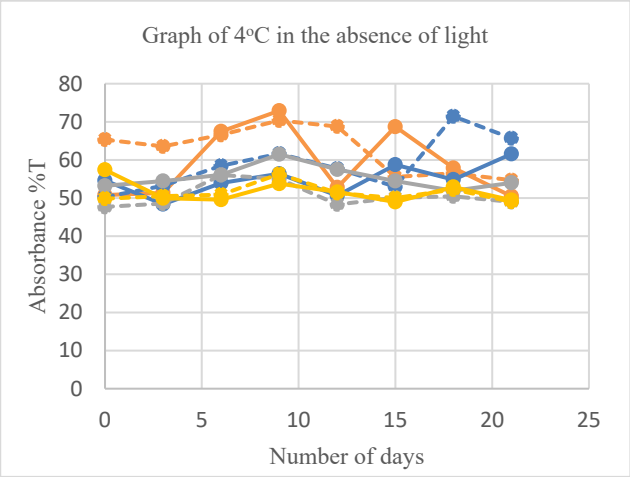


Fig 1 (ii): Graph of absorbance of *tempoyak* samples at 4°C in the absence of light.

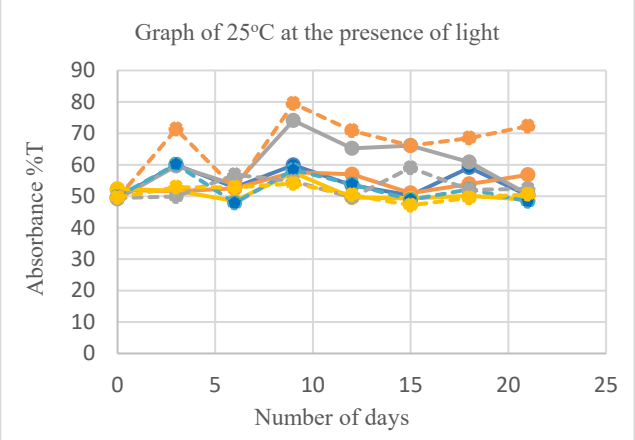


Fig. 1 (iii): Graph of absorbance of *tempoyak* samples at 25°C in the presence of light.

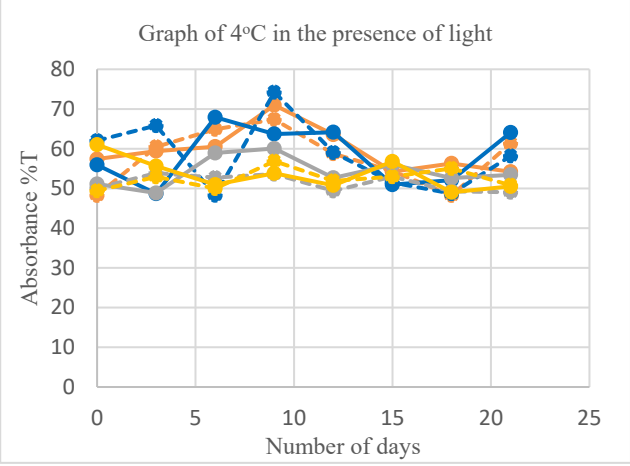
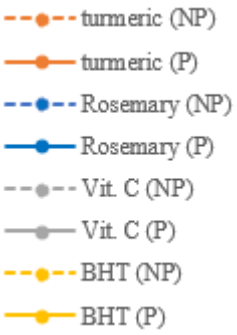


Fig. 1 (iv): Graph of absorbance of *tempoyak* samples at 25°C in the presence of light.

Legends for Fig.1:



It is quite difficult to analyze the overall trend of these four graphs because all of them do not show linear changes overall. Some of the spectrum shown has a weak bands property which shows the presence of alcohol (O-H group) in the absorption spectrum in between 2700-3200 cm^{-1}, especially when the *tempoyak* samples are added with turmeric. The most stable spectrum is *tempoyak* added with BHT which shows minimal overall changes. Rosemary shows the most fluctuations at 4°C in the presence of light[2].

3.2 Chromameter analysis

Results from chromameter test shows that the colour of the samples changed from the initial colour of *tempoyak* that is light yellow in colour. After 21 days, the additives affect the colour of the *tempoyak* in different ways. Figure 2 below shows the change of colour of *tempoyak* after 21 days.

(i)

(ii)

(iii) **(iv)**

Fig. 2: Colour of *tempoyak* samples at **(i)** 4ºC (absence of light; pressurized); from left front going counter clockwise is BHT, turmeric, rosemary and vitamin. C. **(ii)** 4ºC (presence of light; pressurized); from front going counter clockwise is vitamin. C, BHT, rosemary, turmeric. **(iii)** 25ºC (absence of light, pressurized); from front going counter clockwise is vitamin. C, BHT, rosemary, turmeric. **(iv)** 25ºC (presence of light; pressurized); from front going counter clockwise is turmeric, vitamin. C, BHT and rosemary.

The biggest difference in the colours of *tempoyak* samples after 21 days are when the *tempoyak* was mixed with vitamin C, probably due to the *tempoyak* samples being oxidized after prolong exposure towards light. Vitamin C is a powerful antioxidant which inhibits oxidation, especially used in avoiding the deterioration of *tempoyak* samples[3]. However, it is important to note that light intensity and heat significantly reduces the amount of vitamin C under storage[2]. Due to the loss of vitamin C, chemical reactions begin to happen within the *tempoyak* samples and produces different colours from the original light yellow. From the figures, the colour of *tempoyak* samples in vitamin C is brown in both 25ºC samples. Even so light plays a major role in decreasing the activity of vitamin C, at 4ºC under light, the colour of the *tempoyak* samples are like one another and is much more stable. This shows that under pressurized environment, the light intensity does not affect the colour of the *tempoyak* samples as much as heat.

The most stable *tempoyak* samples in all four conditions belongs to *tempoyak* samples added with rosemary and turmeric samples as in all four of the samples shows minimal change in colour even though turmeric does give the samples a tint of light green colour after 21 days of storage.

Sample colour may be used as an interpreting index on the deterioration level of colour pigments. In any case, the decreases in the sample were observed to be higher with the higher amount of vitamin C. As far as colour is concerned, it was concluded that these improvements in the colour pigments resulted in colour variations that can be easily discerned and that the use of a dark background for the tests resulted in a greater distinction between the *tempoyak* samples.[4]

3.3 Sensory analysis

Sensory analysis shows that most of the *tempoyak* samples under pressurized and non-pressurized conditions shows a foul degradation after 21 days of storage, under 25ºC. *Tempoyak* samples especially vitamin C and BHT starts to show the presence of mould. Vitamin C and BHT gives a foul smell and bad coloration while turmeric and rosemary are able to maintain the coloration even though it does still emit a slight sour smell.

Tempoyak samples under 4ºC gives the best result when it comes to coloration, smell and taste. Lactic acid produced by bacteria-generating lactic acid is a good method for acid production. Acid production at temperatures below 20° C is slow or absent. The range of temperature growth is between 10-42 °C, growth is inhibited at temperatures above 39 °C, and the optimum range of growth is between 20-35 °C for *Lactobacillus sp*.[5]. *Tempoyak* sample with rosemary samples still gives a sweet smell overall, followed by turmeric, BHT and vitamin C additives. Sensory analysis was not determined on samples stored under 25ºC in concern to side effects because after 21 days of storage, the samples show signs of deterioration based on the unsatisfactory smell and distinctive coloration.

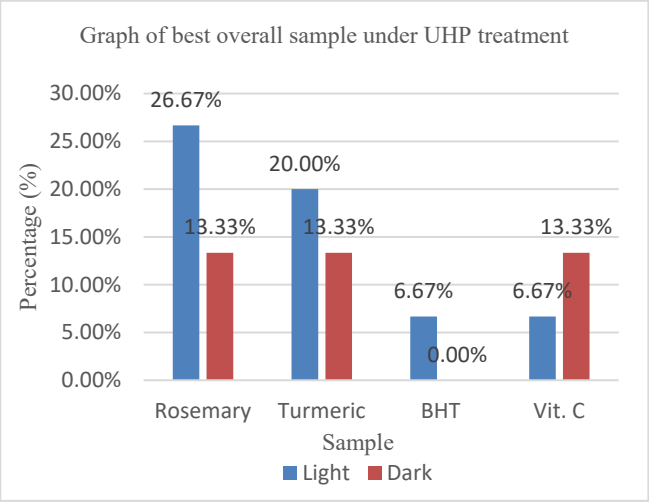


Fig 3 (i): Graph of best overall sample under UHP treatment

Rosemary, turmeric and BHT in the exception of vitamin C shows a better preference on *tempoyak* samples that is being stored under light conditions. This is in accordance to the colour they provide as discussed in the previous section (Section 3.2). Overall, *tempoyak* samples that were stored in darker environment shows better colour that increase the visual properties of the samples. Rosemary sample gives the best smell followed by turmeric samples while BHT and vitamin C do not emit any additional odor. None of the panellists prefer BHT especially stored under lighted environment probably due to the slight color deviation from the other samples, as shown in Fig. 2 (1), BHT sample has a dark yellow-brownish color to it which makes a weird visual perspective on how the colour of *tempoyak* should be.

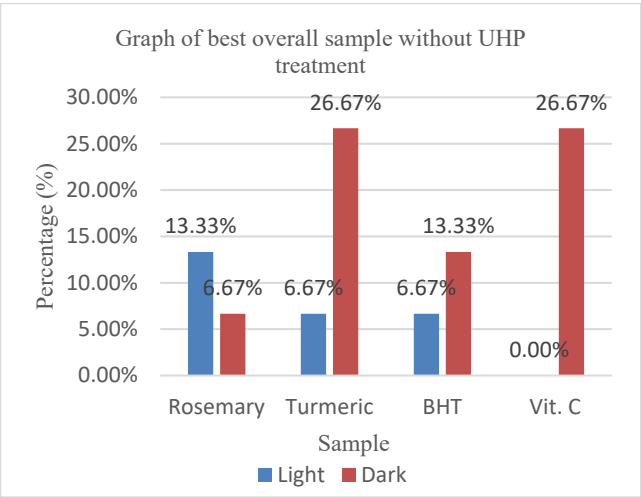


Fig 3 (ii): Graph of best overall sample without UHP treatment

Majority of the panellists prefer vitamin C and turmeric samples that is stored in dark environment. In exception to rosemary sample, the panellists prefer turmeric, BHT and vitamin C stored in dark environment.

BHT samples are not as popular as the other samples either under UHP treatment nor without UHP treatment due to the blandness in taste. Some of the panellists prefer rosemary and turmeric due to the bitterness they add to flavour, making the overall sense of tasting better. The coloration also plays major role as it gives certain idea on how the sample are expected to taste which is called as flavor perception. This is "best conceptualized as the interplay between multisensory integration and expectancy effects"[6][7].

4.0 Conclusions

In conclusion, the evidence reviewed shows that High Pressure Processing (HPP) does play a role in preserving the characteristics of the *tempoyak* samples, however, even after the treatment the *tempoyak* samples should still be stored under low temperature and preferably in dark environments. This is to ensure the chemical reactions within the *tempoyak* bodies could work at a slower pace, allowing more room for time to preserve the sample. This experiment also suggests the importance of colour in food judgement. Flavor can be used as a term to describe the mixture of flavors, odors, trigeminal and sensory stimuli, as well as the visual and auditory signals that we experience when we eat food[8]. Minimal colour change in the *tempoyak* sample of under HPP treatment and stored under 4°C could prove that the sample might be able to be preserved for longer duration, possibly up to 1 year.

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