

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1. Theoretical Background

##### 2.1.1. Kersen

The people use plants as medicine since hereditary. One of the nutritious plants for medicine is kersen (Kholifaturrokhmah and Purnawati, 2016). *Muntingia calabura* L. (family Elaeocarpaceae), the sole species in the genus *Muntingia*, is a flowering plant native to southern Mexico, the Caribbean, Central America, and western South America. The tree grows very easily and is widespread, and, in Malaysia, it is popularly known as “*Kerukup Siam*.” Despite less attention given to its medicinal values in the Malay folklore medicine, *M. calabura* has been traditionally used by the Peruvian to treat various ailments (Jensen, 1999). Kersen fruit is a source of antioxidants because it contains flavonoids, phenols, niacin and  $\beta$ -carotene (Kolar, 2011).

Mentioned by Tjitrosoepomo (1991) kersen plants had the taxonomic positions as follows:

Kingdom	: <i>Plantae (plants)</i>
Division	: <i>Spermatophyta (seed Plants)</i>
Class	: <i>Dicotyledoneae: (Plant seeds side/dichotil)</i>
The Nation	: <i>Malves/Columniferae</i>
People	: <i>Elaeocarpaceae</i>
Genus	: <i>Muntingia</i>
Species	: <i>Muntingia calabura L.</i>



**Figure 1 Kersen Tree**



**Figure 2 Kersen Fruit**

Kersen (*Muntingia calabura* L.) is a shrub plant with fast leaf growth. The kersen tree has a height of 7-10 m with branches with flat shapes. The kersen has leaves that are 5 to 12.5 cm long with long elongated shapes with feather ends (Shih et al.2006). The utilisation of plant seeds has been carried out by a small number of people (Siddiqua et al. 2010). Fruit from kersen can be consumed fresh or often cooked and made jam, infusion of flowers as antispasmodics, while an infusion of leaves can be taken similar to tea, Khusnawati and Sulistyowati (2014) examined that kersen leaves can be used as tea drinks because of their similarity in carbohydrates, vitamin C, caffeine and polyphenols content. Also, in a study conducted by Yudrik and Latif (2016), there was an interaction effect of concentrations of kersen leaves on total acid, moderate pH and antioxidant activity, and fermentation products and concentration variants of kersen leaves as good quality, healthy, and halal products. The following are the nutritional values of per 100 g of kersen:

**Table 2 the chemical composition  
of fresh kersen fruit per 100 grams**

<b>Composition</b>	<b>Number of content total</b>
<b>Moisture</b>	<b>80.43 g</b>
<b>Protein</b>	<b>0.53 g</b>
<b>Fat</b>	<b>0.05 g</b>
<b>Carbohydrates</b>	<b>16.85 g</b>
<b>Fibre</b>	<b>4.22 g</b>
<b>Ash</b>	<b>0.78 g</b>
<b>Thiamin</b>	<b>0.84 mg</b>
<b>Pectin</b>	<b>0.05 g</b>
<b>Sugar</b>	<b>4.53 g</b>
<b>Energy</b>	<b>67.59 kcal</b>

*Source: Laswati et al., 2017*

The study stated that the kersen fruit is one of the plants that is thought to contain active antidiabetic ingredients, namely ascorbic acid, fibre,  $\beta$ -carotene, thiamine, and niacin (Verdayanti, 2009). Another study of the effect of extracting 100 mg / kg body weight, 200 mg / kg body weight, 400 mg / kg body weight in white rats with diabetes induction, concluded that extract of 100 mg/kg BB significantly affected the decrease in blood sugar levels ( $P < 0.05$ ) (Pramono et al. 2014). Research conducted on 20 male rats showed that juice administration changed reducing blood uric acid levels in mice (*Mus musculus*) because the kersen fruit contained low levels of purine and contained flavonoids (Meiliza, 2013). Research conducted by Sarimanah et al (2015) using kersen at doses of 50 and 100 mg/kg showed that there was an anti-inflammatory effect in white *wistar* rats fed with unripe fruits and leaves from kersen.

### 2.1.2. Date Palm

Dates (*Phoenix dactylifera*) or in Arabic commonly called Tamar is sweet fruit with the sugar content of more than 50% which is a major complaint and is one of the critical economic sectors in the Middle East (Augstburger, 2002).

Mentioned by Alebidi (2008) plant taxonomic position has the date as follows:

Kingdom	: Plantae Division: <i>Magnoliophyta</i>
Class	: <i>Liliopsida</i>
The Nation	: <i>Arecales</i>
People	: <i>Palma</i>
Genus	: <i>Phoenix</i>
Species	: <i>P. dactylifera</i>



*Source : Brown, 2019*

*Source : Hodel, 2007*

Dates (*Phoenix dactylifera*) also included family Palme & often called dates, has a various nutritional content and can function as a medicine. Dates are foods that contain high energy with an ideal composition, which include carbohydrates that contain tryptophan, omega-3, vitamin C, vitamins B6, Ca<sup>2+</sup>, Zn, and Mg. Date palm fruit contains very high fibre besides it also contains potassium, manganese, phosphorus, iron, sulphur, calcium

and magnesium. Iron content can increase haemoglobin levels in the body. So that for women of reproductive age and pregnant women it is highly recommended (Gibney et al. 2009).

The following are the nutrients in dried date deglet noor per 100 grams according to Al-farsi and Lee (2008):

**Table 3. The value of Nutrients per 100 grams of dried Deglet Noor date**

<b>Parameter</b>	<b>The cost of the deglet noor date</b>
<b>Moisture</b>	<b>20,5 g</b>
<b>Ash</b>	<b>1,6 g</b>
<b>Energi</b>	<b>290 g</b>
<b>Protein</b>	<b>2,5 g</b>
<b>Fat</b>	<b>0,4 g</b>
<b>Carbohydrates</b>	<b>75,0 g</b>
<b>Ca</b>	<b>39 mg</b>
<b>Fe</b>	<b>1 mg</b>
<b>Zn</b>	<b>0,3</b>
<b>Total Fibre</b>	<b>4,0 g</b>
<b>Phenolic</b>	<b>661 mg</b>

*Source: Al-farsi and Lee, 2008*

Dates contain antioxidant compounds, namely phenolic compounds such as flavonoids (Biglari, 2008). The dates with the highest phenol content are Deglet Noor which equal to 661 mg / 100 g (Al-farsi and Lee, 2008). The study conducted on 50 wistar rats for 112 days. This study showed that raw methanol and date fruit extract (*Phoenix dactylifera*) can have properties that can support the increased synthesis of erythropoietin by the liver to stimulate the bone marrow to produce more red blood cells/haemopoiesis (Onuh, 2012). Dates affect the increase in haemoglobin levels (Hb) 3.59 gr/dl (Nugroho et.al, 2017). Administration of dates for one day, one week and two weeks

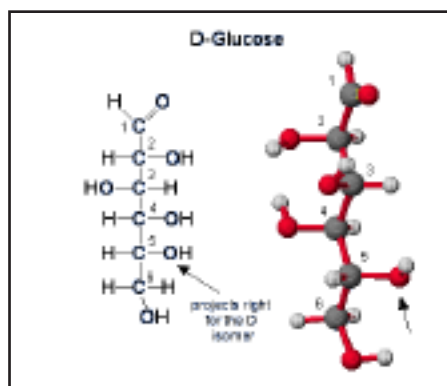
reduce the percentage of mouse monocytes (Dzikro, 2012).

### 2.1.3. Energy

The carbohydrate, protein, fat, and alcohol are a source of energy in the diet. Energy obtained from the oxidation process carbohydrate, fat, and protein in the food. The unit of measurement used calorie. The amount of energy produced from the oxidation of carbohydrate, fat and protein can be measured in a laboratory (Beck, 2011). Carbohydrat content in 100 grams of kersen fruit as much as 67.59 kcal (Laswati et al.2017).

### 2.1.4. Carbohydrates

Carbohydrates are compounds formed from molecules of carbon, hydrogen and oxygen. As one of the types of nutrients, the primary function of carbohydrates is a producer of energy in the body (Irawan, 2007). Carbohydrates consist of element C, H, and O the number of atoms of hydrogen and oxygen with the comparison of 2:1 (Poedjiandi, 1994). Carbohydrate content in 100 grams of kersen fruit as much as 16.85% (Laswati et al., 2017). Here is a picture of bond glucose as carbohydrate is simple:



**Figure 3. Ring Structure for glucose**

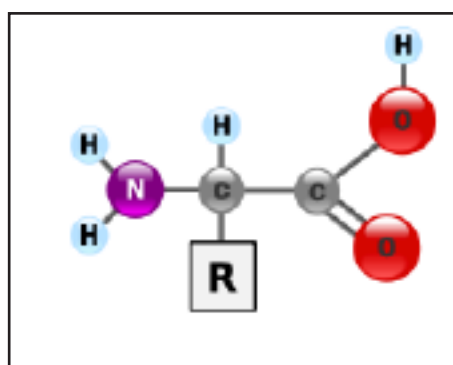
*Source : (LibreTexts, 2019)*

The results of research Rakhmi (2008) showed that the kersen

fruit with a dose of 100 mg can lower blood glucose levels.

### 2.1.5.. Protein

Protein content in 100 grams of kersen grain is 0.53% (Laswati et al., 2017). Estimation of protein showed that extracts of the leaves have more protein content of about 1 mg/ml followed by fruit extracts (0.8 mg/ml) and interest (0.6 mg/ml). Very little quantity observed in fruit extracts Kersen (Singh et al., 2017). Here is a picture of the structure of the protein bonds:

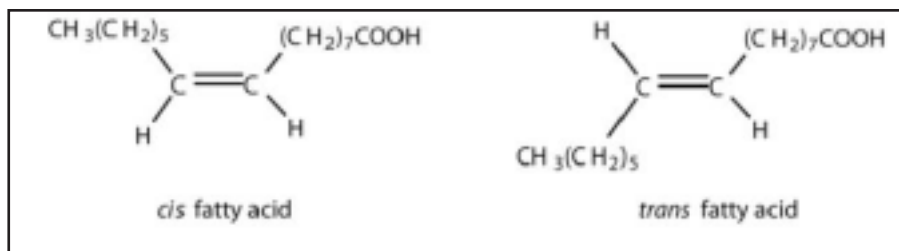


**Figure 4 Amino acids Bonds**

*Source : Wikipedia, 2019*

### 2.1.6. Fat

The fatty acid is an organic acid that consists of a chain of hydrocarbon straight on one end has a carboxyl group (COOH) and at the other end of a methyl group (CH<sub>3</sub>). Natural fatty acids usually have a chain with the number of even-numbered carbon atoms, which ranged from four to twenty-two carbon (Almatsier 2010). The fat content in 100 grams of kersen fruit is 0.05% (Laswati et al., 2017).



**Figure 5 Fatty Acid**

*Source : Libretexts, 2019*

Fatty acids serve as the densest energy source, which produces nine calories for each gram, which is 2½ times the amount of energy produced by carbohydrates and proteins in the same amount. The means of transporting fat-soluble vitamins and saving protein is giving a feeling of satiety and delicacy, as a lubricant, maintaining body temperature (Poedjiandi, 1994).

### 2.1.7. Antioxidants

Antioxidants are compounds that provide electrons, whereas, in the biological sense, antioxidants are molecules or compounds that can reduce free radical activity by preventing cell oxidation (Syahrizal, 2008). Kersen fruit is a source of antioxidants because it contains flavonoids, phenols, niacin and β-carotene (Kolar, 2011). The mechanism of antioxidants in inhibiting oxidation reactions or stopping the free radical chain from oxidized fat can be caused by four types of reaction mechanisms, namely: hydrogen release from antioxidants, electron release from antioxidants, addition of fat into aromatic antioxidant rings, and formation of complex compounds between fat and rings aromatic antioxidants (Winarti, 2010). Antioxidative function of HDL can be impaired in several metabolic and inflammatory diseases. Structural and compositional anomalies in the HDL proteome and lipidome underlie such functional deficiency (Brites, 2017).



### 2.1.8. Phenol

Antioxidants divided into two groups, natural and synthetic antioxidants. Natural antioxidant derived from plants because they contain phenolic compounds, nitrogen (Agati et al, 2012). The content of phenolic compounds in natural antioxidants was associated with raw materials as in the process of photosynthesis by plants; this affect the antioxidant activity (Naiyana et al. 2010). Dried Kersen leaf extracted by methanol showed that tea leaves contain phenolic substances, saponins, tannins, flavonoids and anthraquinone (Siddiqua et al. 2010). Kersen leaf powder constituent compounds identified by GC-MS; LC-MS; FTI-R, phenolic compounds, consisting of polyphenol and flavonoid. The functional group identified as OH str, Aromatic ethers and DPPH test values higher than the synthetic antioxidant (BHT). So Kersen leaf powder can be used as natural antioxidants (Triswaningsih, 2017).

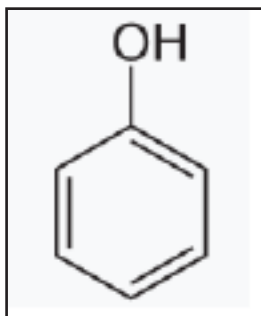


Figure 6. Phenol Bonds

Source : Wikipedia, 2019

**Table 4. Phenol of kersen and Deglet Noor date**

<b>Content</b>	<b>Kersen</b>	<b>Deglet Noor Date</b>
<b>Phenol (mg / 100 g)</b>	<b>11,3<sup>a</sup></b>	<b>661<sup>b</sup></b>

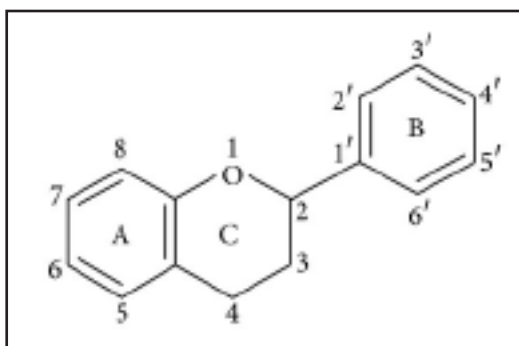
Source : (Al-farsi and Lee, 2008) <sup>a</sup>, (Consolacion et al, 2015)

Table 4 are the total phenol levels in the kersen and date deglet noor. There is a lot more phenol in the Deglet Noor than the kersen. Both had difference around 649.7 mg per 100 gram.

### 2.1.9. Flavonoids

Flavonoids are phenolic compounds that belong to the groups of which are found in many plant tissues and can act as antioxidants — the activities of anti-oxidative flavonoids on the ability of the hydrogen atom dominate (Redha, 2010). Flavonoids are one of the contents of Antioxidants found in plants of the Kersen (*Muntingia calabura l.*). Other than that are, there is a triterpenoid saponin, steroids and tannins, demonstrate antioxidant activity (Kuntorini et al, 2013). Qualitatively it is known that the dominant compound in kersen leaves is flavonoid (Kuntorini et al, 2013).

Flavonoid in Kersen is a type of flavonoid Quercetin. Quercetin can decrease uric acid blood. Work of quercetin in lowering the levels of uric acid is in a way an oxidase activity xanthine snuff which is the enzymes that synthesise uric acid (Sulistyowati, 2010). The Study conducted on male mice showed the tail 20 granting of kersen juice to decrease blood levels of the uric acid house mouse (*Mus musculus*) because the kersen fruit contains low levels of purine and contains flavonoids (Meiliza, 2013).



**Figure 7 Basic Flavonoid Structure**

Source : Kumar, 2013

Table 5. Flavonoids of kersen and deglet noor

Content	Kersen	Deglet Noor Date
<b>Flavonoid</b>		
<b>Rutin (RE mg /100 g)</b>	<b>2,31<sup>a</sup></b>	<b>1,224<sup>b</sup></b>
<b>Myricetin (ME mg /100 g)</b>	<b>21,08<sup>b</sup></b>	-
<b>Luteolin (LE mg /100 g)</b>	<b>0,18<sup>d</sup></b>	
<b>Rhamnosyl dihexosyl luteolin (m/z)</b>		<b>757<sup>d</sup></b>
<b>Di-hexosyl luteolin sulfate (m/z)</b>		<b>691<sup>d</sup></b>
<b>Rhamnosyl dihexosyl methyl luteolin (m/z)</b>		<b>771<sup>d</sup></b>
<b>Rhamnosyl hexosyl luteolin (m/z)</b>		<b>595<sup>d</sup></b>
<b>Rhamnosyl hexosyl methyl catechin (m/z)</b>		<b>609<sup>d</sup></b>
<b>Hexosyl catechin sulfate (m/z)</b>		<b>529<sup>d</sup></b>
<b>Hexosyl methyl catechin sulfate (m/z)</b>		<b>543<sup>d</sup></b>
<b>Quercetin (QE mg /100 g)</b>	<b>1,03<sup>d</sup></b>	<b>24,5<sup>e</sup></b>
<b>Apigenin (AL mg /100 g)</b>	<b>1,62<sup>d</sup></b>	
<b>Apigenin di-C-hexoside (m/z)</b>		<b>595<sup>d</sup></b>
<b>Kaempferol (mg)</b>	<b>2,30<sup>d</sup></b>	<b>0<sup>b</sup></b>

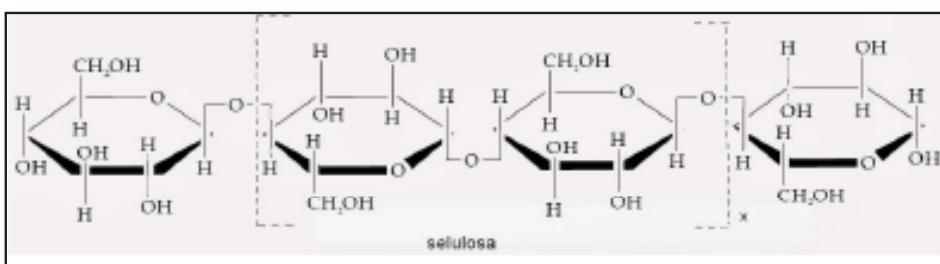
Source : (Kubola et al., 2011)<sup>a</sup>, (Hamid et al., 2018)<sup>b</sup>, (Saryono et al, 2018)<sup>c</sup>, (Hong et al, 2006)<sup>d</sup>

Table 5 are flavonoids types found in kersen and dates. Kersen has more types of flavonoids than Deglet Noor date. The quercetin flavonoid types in the Deglet Noor are more numerous than the kersen, but the kersen has more myricetin (type of flavonoids). The myricetin in Deglet Noor date has not found in the other journals.

### 2.1.10. Fibre

Fibre is a non-starch polysaccharide (NSP) which consists of a mix of polymers, such as cellulose, hemicellulose, and pectin, the main component of the cell wall and physiological (Trinidad et al, 2010).

Food sources of fibre have a low glycemic index. Fibre also lowers the risk of hypoglycemia. Since one of the intrinsic factors that can affect the glycemic index is a fibre (FAO/WHO, 1998). The variation of the value of the IG the fruit influenced by intrinsic factors, namely the composition of sugar, food and fibre structure, concentration solute and organic acids, polyphenols, compounds and the level of maturity of the fruit (Hoerudin , 2012).



**Figure 8. Fibre Bonds**

*Source: Evgust , 2011*

### 2.1.11. Jelly

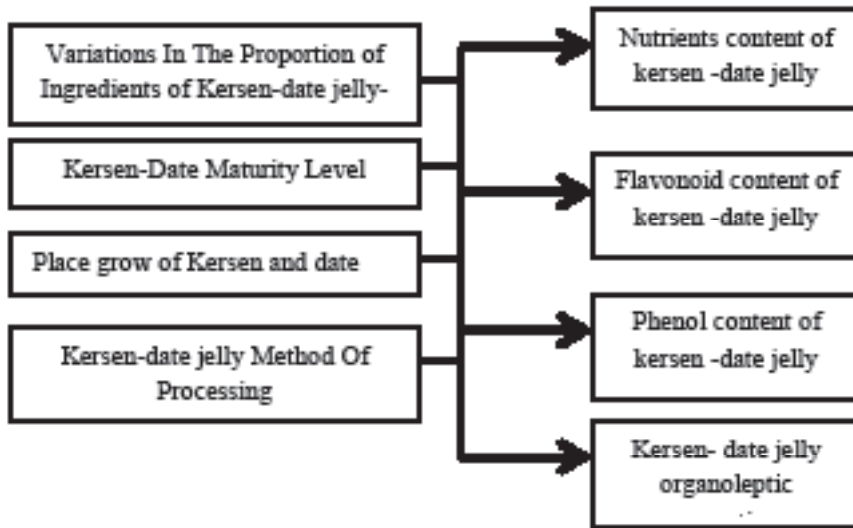
Jelly strictly defined in the United State is semi-solid food made from no fewer than 45 part heavy ingredients fruit juice for each 55 part heavy sugar. This mixture concentrated on no less than 65 per cent of the dissolved solids, pectin and acid can be added to address the deficiencies that occur the fruit itself (Smith, 2006). Jelly made from fruit juice and sugar. The terms of a good jelly are transparent, smeared easily and have a scent and the original fruit flavours (Koswara, 2006). According to Ide (2009), Pectin is also known as ant cholesterol because it binds bile acids that are the result of the metabolism of cholesterol. The more bile acids related to pectin and removed from the body, the more cholesterol is metabolised. It had make cholesterol decrease. Pectin also absorbs excess water in the intestine. Weaken this stool, as well as binding and eliminating toxins in the gut. Flavourings substances and dyes can also added (Smith, 2006). The quality requirement of

SNI 3547.2 -2008 about the water content and the levels of grey jelly sweets as much as moisture content maximum 20.0% and a maximum ash rate 3.0% (Wijana et al, 2014).

## **2.2. Theory Framework**

The Study conducted by Bogdanov et al. (2008) showed no difference in carbohydrate if there are additional variations of honey in food. In addition to the biological effects of carbs, such as antimicrobial, antioxidant, antiviral, ant parasitic, bitter taste, anti-cancer, anti-mutagen, and immunosuppress activity. The level of maturity of the fruit of the influential real against solids the total amount of dissolved and total acid, but does not affect the weight of real fruit juice, burdens, and vitamin C fresh fruit on the quotation. Purple sour passion fruit can already be harvested at a rate of 50% maturity for purple produce fruit weight, fruit juice content, total dissolved solids and total acids are highest, each of 54.73 g/fruit, fruit 29.87 g/12,12° Brix, and 3.03%, but vitamin C produced relatively low (71.28 mg/100 g of material) compared to the 75% level of maturity (78.32 mg/100 g of content) and purple 100% purple (75.68 mg/100 g of substance) (Silalahi et al,2007).

The Study conducted by Milana et al. (2016) showed a growing area where the influences that have soil with a high content of Ca form compounds of Flavonoids in plants. The analysis showed the cooking process of food causes a decrease in the levels of nutrients in food than the raw material. High or low nutrient levels decrease due to cooking depending on the type of food, the temperature and the longer of cooking process. The frying process causes a decrease in nutrient content was highly significant because of high temperatures so that nutrients such as protein damage. The boiling process leads to reduced nutrient content because many nutrients dissolved in boiling water. Compared with the research above, the research that carried out to this theoretical framework:

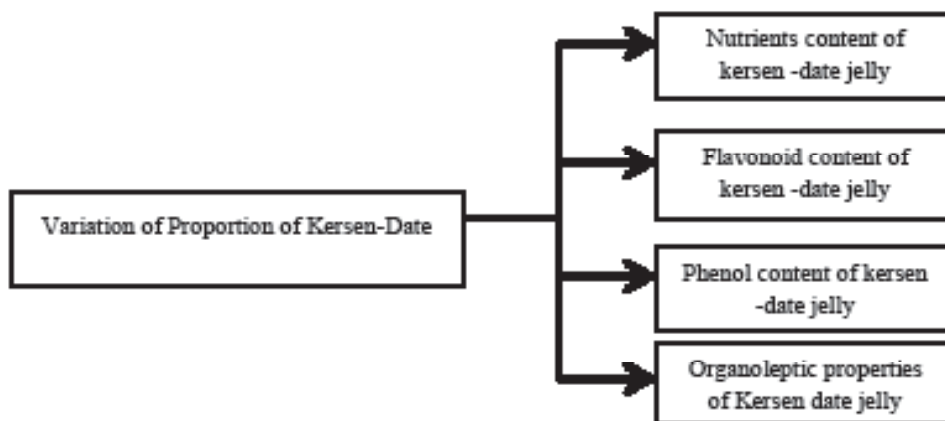


**Figure 1. Theory framework**

*Modified from : Bogdanov et al. (2008), Silalahi et al. (2007), Milana et al. (2016), Sundari et al. (2015).*

### 2.3. Conceptual Framework

On this research has been paying attention to the level of maturity of the kersen with the reddish colour to red ripe fresh and dried date or dried date import. Kersen used was kersen that grow on the land of Gontor for girls 1 and 2, Sambirejo, Mantingan, Ngawi, East Java, Indonesia. The process methods used were only microwave heating, fire from the stove. So this research is focused on the variations of the proportion of materials that affect the content of nutritional substances, flavonoids, phenols, and kersen-date jelly organoleptic, than the research that carried out to this conceptual framework:



**Figure 1. the conceptual framework**

## **2.4. The Hypothesis**

### **2.4.1. Major hypothesis**

The major hypothesis of this research is there a difference between proximate, antioxidant, and organoleptic of kersen and date jelly mix with variation composition.

### **2.4.2. Minor hypothesis**

The Minor hypothesis of this research are :

- a. There is a difference proximate of kersen and date jelly mix with variation composition.
- b. There is a difference antioxidant of kersen and date jelly mix with variation composition.
- c. There is a difference organoleptic of kersen and date jelly mix with variation composition.