

## **Study on Effect of Different Binding Agents on Texture of Frozen Potato Patty by Sensory Evaluation Analysis**

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### **Abstract**

Plant-based frozen products such as potato patty (begedil) are relatively easy to process and become a product of choice for local small and medium entrepreneurs. However, its olfactory attributes are impeded if thawing is required prior to any other consumption. Besides, the moisture is readily separated from the matrix and lead to softening of the texture, drip loss and deterioration of overall quality thus shortening its keeping quality. The aim of this study was to overcome the aforementioned problems by manipulating the binding properties of different types of flour; tapioca, potato, and corn flour coupled with planned processing steps. Three formulations were developed and labeled as F1, F2 and F3 which used tapioca flour, corn flour and potato flour as binding agents respectively where they are singly added into prepared ingredients and then froze at  $-4^{\circ}\text{C}$ . Samples were tested weekly to observe their binding abilities during frying ( $180^{\circ}\text{C}$ ) as well as their sensory attributes where 30 trained panelists were instructed to evaluate the texture, meatiness and overall acceptance. This study showed that F1, formulation that used tapioca flour as binding agents was found to be the most outstanding binder with an acceptable eating quality that lasted for 91 days if the kept frozen.

**Keywords:** potato, texture, quality, frozen, binding agent

### **1.0 Introduction**

As the demand for ready-to-eat food items rises, a variety of frozen foods are continually introduced in markets. One of the frozen foods that has becoming family favourite is potato patty. They are known as 'begedil' in Malaysia, Singapore, Indonesia and Brunei. It is a popular side snack eaten alongside of another main food (Lee et al, 2002). Basically, potato patty is produced by mixing mashed potato with other ingredients such as, comminuted meat, onion and colander leaves. The mixer is then formed into round shape and fried in cooking oil before eaten as a snack food or together with rice and other daily dishes (Nurul et al., 2009). However, when potato patty is frozen, the formation of ice crystals within the food

matrix cause physical stress to food. Upon thawing, the melting of these ice crystals led to moisture loss and the softening in food texture, which consequently affect the overall quality of the food (Viriya & Manop, 2006).

To overcome above mentioned problem, starch flour has been incorporated in many frozen foods as thickening agent and contributes to the stabilizing effects and texture modification (Eliasson & Gudmundsson, 1996). Starches are multifunctional applications, including adhesion, binding, emulsion stabilisations, gelling and moisture retention (Mbougoung et al., 2015). However, when starch-containing foods, i.e., starch pastes, are subjected to either storing or freezing and thawing conditions, their texture become more rigid resulting from the hydrogen bonding of amylose and amylopectin components in starch (Funami et al., 2005). This process is termed retrogradation and is accelerated by freezing and thawing and eventually release water (Yuan & Thompson, 1998). Bakers & Rayars, 1998 reported that wheat and rice starch gels showed the syneresis of 37% and 26% respectively when repeated by 2 cycle of freeze-thawing process. Waxy barley and waxy maize starch gels gave up 55% water by seven freeze-thawing cycles (Wu & Seib, 1990).

The aim of this study was to determine effect of tapioca flour, corn flour and potato flour acted as binding agents in improving texture of frozen potato patty. Tapioca flour, corn flour and potato flour has been widely used as binding agent in foods because it improves the physical properties and minimises syneresis (Lee et al., 2002).

## **2.0 Methodology**

### **2.1 Materials**

Potato was supplied by Arda Food Industries. Tapioca flour, corn flour and potato flour were obtained from Union Chemical 1986 Co. Ltd Bangkok, Thailand.

### **2.2 Sample Preparation**

Type of potato used is Russets. Russets are ideal for light and fluffy mashed potatoes. They also fry up crisp and golden brown, and they are the potato of choice for baking. The delicate flavour and fluffy texture of baked russets go well with all kinds of toppings, from traditional sour cream and chives to spicy and bold Mediterranean or Latin flavours. Potatoes were supplied by Arad Food Industries and were physically examined to ascertain its wholesomeness. Each of the potato was washed thoroughly before wiped with a dry cloth. Fresh potatoes were peeled and chunked with a minimum thickness of about 2 inches. The chunked potatoes then fried at 180°C, mashed and added up with other ingredients. Three different formulation were developed using tapioca flour, corn flour and potato flour as variables. The mixer was then shaped into standard size and froze at -4°C.

### 2.3 Cooking

A wire-mesh basket was filled with frozen potato patties and immersed in preheated oil at 180°C. The products were fried for 10 minutes and sensory evaluation test were performed within 30 minutes.

### 2.4 Sensory Evaluation

Thirty panelists were randomly chosen among the students at Food Technology Department. A total of 3 samples were evaluated simultaneously with a cup of drinking water for palate cleansing purpose between sampling. Approximately 12g of samples were placed on a plate and panelists rated the firmness, meatiness and overall acceptance of the product based on 7-point hedonic and scoring scale. (1= like extremely, 4= neither like nor dislike, 7 = dislike extremely).

### 2.5 Statistical Analysis

A Statistical Analysis System (SAS Institute, Inc., Version 17.0) was used to conduct analysis of variance (ANOVA), to determine the effect of different binding agents on the texture, meatiness and overall acceptance characteristics of the product.

### 3.0 Result and Discussion

Table 1 shows three different formulations developed using three types of starch flour acted as binding agents. F1 used tapioca flour as binding agent, while F2 and F3 used corn flour and potato flour respectively.

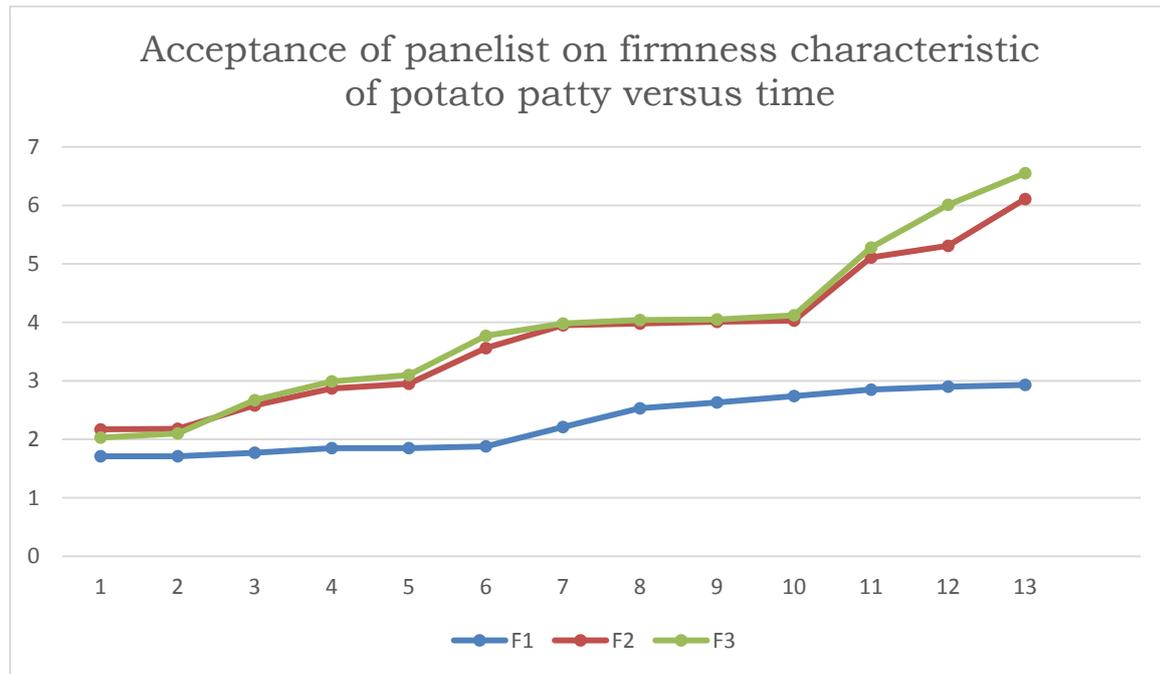
**Table 1:** Ratio of potato patty using different starch flour as binding agent

Raw Material	Formulation		
	1	2	3
Potato	90%	90%	90%
<b>Binding agent</b>			
Tapioca Flour	5%		
Corn Flour		5%	
Potato Flour			5%

Starch has been widely used in the food industry as an adhesive, binding, gelling and thickening agents because of the pseudo plastic properties of gelatinized starch. (Rungnaphar et al., 2010). However, the physical properties of certain starch pastes often limit commercial applications in products due to low stability against heat or shear. As it is known that during storage, certain starch, aggregation or recrystallization of starch bio-polymers in starch granules can occur and lead to increased rigidity and syneresis (Liu, Eskin & Cui, 2003). The water consequently leaves the starch gel sponge-like (Ferrero et al., 1994).

When a starch gel is frozen, starch-rich regions are created in the matrix, where water remains partially unfrozen. High solid concentration in the regions facilitates the starch chains to associate forming thick filaments, whereas water molecules coagulate into ice crystals forming a separate phase (Lee et al., 2002).

The purpose of this research was to investigate the influence of different binding agents on texture of frozen potato patty based on Sensory Evaluation Test.



**Figure 1:** Acceptance of panelist on firmness characteristic of potato patty for F1, F2 and F3.

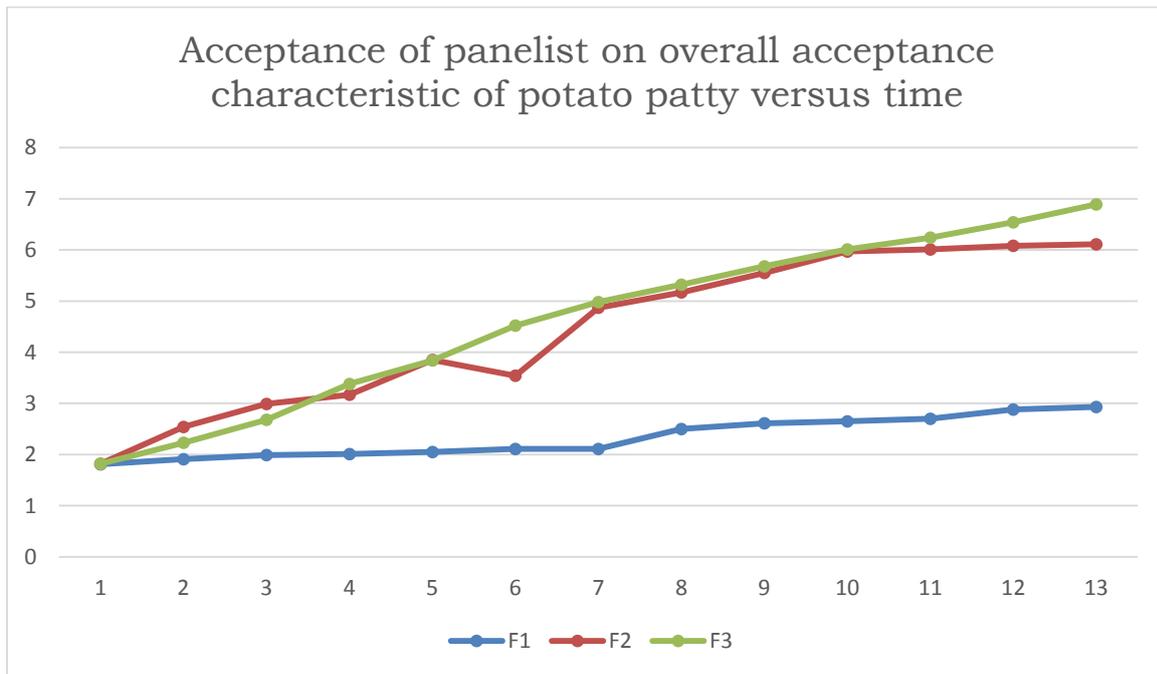
Figure 1 shows result of acceptance of panelist on firmness characteristic of potato patty done weekly. These values were obtained by Sensory Evaluation Analysis (Hedonic Test). Results showed that there are significant differences ( $p < 0.05$ ) between Formulation 1 and the other formulations. Firmness of potato patty at week 13 still acceptable by panel which showed value of 3 which is “slightly like”. F2 and F3 showed that there are no significant differences between those two formulations. Formulations that used potato flour as binding agents showed value of 6.7 at week 13, which indicate “dislike extremely”.

At week 13, the texture of potato patty that used corn flour and potato flour as binding agents showed sponge-like and softening food texture.



**Figure 2:** Texture of potato patties when froze for 13 weeks with Formulation 3

As reported by Rapaille & Vanhemelrijck, 1997, tapioca starch is much more widely used as thickener in the food industry compared to other starches, due to its high viscosity, clear appearance, and low production cost.



**Figure 3:** Acceptance of panelist on overall characteristic of potato patty for F1, F2 and F3

Figure 3 shows acceptance of panelists on overall acceptance characteristic of potato patty done. The analysis was done weekly and the values obtained by Sensory Evaluation Analysis (Hedonic Test). Results showed that there are significant differences ( $p < 0.05$ ) between Formulation 1 and the other formulations. Overall acceptance of potato patty at week 13 was still acceptable by panel which showed value of 3 which is “slightly like”.

Dresher et. al., 1983 reported that a gel from corn starch showed approximately 80% water loss by repeating the freeze–thawing cycle up to 14 times. In this study, potato starch (F2) showed a value of 6 for overall acceptance which is indicated ‘Don’t like’.



**Figure 4:** Texture of potato patty when froze for 13 weeks with Formulation 1

Results obtained from hedonic and scoring test showed that tapioca flour plays significant roles as a binding agent where it managed to improve texture of frozen potato patty. Storage of frozen potato patty up to 13 weeks still meets panel acceptance in terms of firmness, meatiness and overall acceptance.

These findings would be able to help local, small and medium entrepreneurs (SME) to penetrate the market. This is becoming possible since tapioca flour compared to other corn flour and tapioca flour, able to improve texture of the foods, and comparatively is cheaper.

#### **4.0 Conclusion**

Among the three binding agents tested, tapioca was most effective in improving texture of potato patty. Tapioca flour thickens at a lower temperature than corn starch and potato flour and remain stable when frozen. Potato patty that used tapioca flour as binding agents was still acceptable by panelists when tested via Sensory Evaluation Analysis. The products still meet consumer expectation even when frozen for 13 weeks.

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