CHAPTER 3
METHODOLOGY

3.1 Materials

3.1.1 Raw material

1. A raw sweet corn variety of ATS-2 that was harvested on 55-60 days after seeding was used in this study. The corn was kept at temperature of –20 °C.
2. Sugar 1 kg/bag (Mitrpol company, Chaiyapoom, Thailand).
3. Distilled water.

3.1.2 Chemical

1. Methocel, a food grade (O.V. Chemical and supply, Chiang Mai, Thailand).
2. Glyceryl monostearate (GMS), a food grade (O.V. Chemical and supply, Chiang Mai, Thailand).
3. Maltodextrin DE 9-12, a food grade (O.V. Chemical and supply, Chiang Mai, Thailand).

3.1.3 Packaging

1. Aluminum foil (OPP/AI/PE), 125x205 mm (Packmart company, Bangkok, Thailand).

3.2 Equipment

3.2.1 Equipment for producing corn milk powder

1. A tray dryer (Kuinamthai Dryer Company, Bangkok, Thailand).
2. Aluminum trays, 40x60 cm.
3. A kitchen aid model KPM 5 (Hobart, USA).
4. A juice extractor (National, USA).
5. An analytical balance model SE-1005 (Zepper, Germany).

3.2.2 Equipment for analysis

1. A hot air oven model ULM 500 (Memmert, European union).
2. An analytical balance model CP 2245 (Sartorius, Germany).
3. A water activity ($a_{w,}$) measurement device, Aqualab Model Series 3, model CX3TE (Decagon Device Inc, USA).
4. A colorimeter (Minolta Data Processor DP-301 Chroma Meter, Japan)
5. A hand refractometer model N1 for 0-32 °Brix (ATAGO, Japan).
6. A spectrophotometer, thermo spectronic, model B10MATE5 (Biomate, England).
7. A refrigerated centrifuge, ROTINA46R (Hettich, Germany).
8. A viscometer (Cannon, Japan)

3.2.3 Statistical analysis hardware and software

1. A computer.
2. A statistical analysis software of SPSSversion 10.0.
3. Microsoft Excel.

3.3 Method

3.3.1 The quality of corn milk

Seeds of sweet corn were separated with knives and steamed for 10 min. Afterwards, the steamed corn was blended with distilled water at a ratio of 1:2 (w/w) and extracted using a juice extractor to produce corn milk (Arunratsamee, 1999).

Physical, chemical and microbiological qualities of corn milk were defined in term of

- color values that were recorded as L*, a* and b* coordinates by using a colorimeter.
- total soluble solids that were determined using a hand refractometer.
- moisture contents that were determined according to an AOAC official method no.925.45 (2000).

- fat content that were determined by the method modified from an AOAC official method no.905.02 (2000).
- protein content that were determined by the method modified from an AOAC official method no.991.20 (2000).
- ash that were determined according to an AOAC official method no.945.46 (2000).
- acidity (titrimetric method) that were determined according to an AOAC official method no.947.05 (2000).
- reducing sugar (the Lane and Eynon method) that were determined according to Rutjanakaikan (2001).
- crude fiber that were determined by the method modified from an AOAC official method no.978.10 (2000) and Rutjanakaikan (2001).
- vitamin C (ascorbic acid) contents that were determined according to a titration method (modified from an AOAC official method no.967.21, 2000 and Rattanapanon, 2001).
- carotenoid contents that were determined according to a spectrophotometer method (modified from an AOAC official method no.941.5, 2000).
- microbial analyses were determined according to methods from Robert *et al*. (1995).
- an extraction rate that was calculated by (Arunratsamee, 1999).

$$\% \text{ extraction} = \frac{\text{weight of corn milk}}{\text{weight of sweet corn}} \times 100$$

3.3.2 A production of corn milk powders by foam-mat drying

3.2.2.1 A study of suitable foaming agent, sugar and maltodextrin concentrations to produce a stable foam.

1. Corn milk from the section 3.3.1 was adjusted to a total soluble solid of 15 and 20 °Brix by an addition of sugar. After that the corn milk was heated to 60 °C (Vongsawasdi *et al.,* 2002) and

added with maltodextrin at various concentrations of 20, 25 and 30 % (w/w).

2. **Foaming agent**. GMS, methocel and a mixture of GMS and methocel at a ratio of 1:1(w/w) were used as foaming agents. Each type of foaming agents was prepared in solutions at different concentrations of 1, 2 and 5 % (w/w). Preparation of foaming agents was done by adding the foaming agents in distilled water which was heated at 70 °C and stirred until they were dissolved. The temperature of the suspension was kept at 70 °C until use (Sankat and Castaigne, 2004).
3. **Foam formation**. The required quantity of freshly prepared GMS and methocel solutions from section 2 was added to 200 g of the corn milk's solution from section 1. The mixture was mixed with a kitchen aid at a low speed for 30 s to facilitate an even distribution of the foam stabilizing agent within the mixture. Further whipping was carried out at a high speed (level no. 9) for 8 min to figure out the minimum quantity of foaming agents which could make a stable foam or a foam that can stand up in well-defined peaks. The maximum quantity of added foaming agent was 100 g.
4. **Drying.** The stable foam was extruded as spaghetti-like strips on aluminium trays using a bag with 5 mm-diameter hole and then air dried at 60 °C for 90 min.
5. **Packing.** Corn milk powders were immediately scraped from the aluminium trays after drying and kept in sealed aluminum foil bags.

The quality of foam was defined in term of

- Foam density was determined according to the method of Ratchaniyom (2002) (see appendix B).

- Syneresis was determined according to the method of Sauter and Montoure (1972) (see appendix B).
- Overrun was determined according to the method of Jitjaroen (1999) (see appendix B).
- Viscosity was determined by using a viscometer (see appendix B).

A factorial in completely randomized design with 3 replications was used in this study. Duncan's New Multiple Range Test (DMRT) was used for indicating the differences between treatment's means.

3.2.2.2 A study on suitable amount of the foaming agents.

1. A minimum amount of foaming agents from the section 3.2.2.1 that made a stable foam was used as a first level in this section. From the first level of foaming agent, the addition of foaming agent was increased for another 4 level. The increasing level of the foaming agent addition was done by adding an extra 10 g (w/w) from the previous level.

The quality of foam was defined in term of

- Foam density was determined according to the method of Ratchaniyom (2002) (see appendix B).
- Syneresis was determined according to the method of Sauter and Montoure (1972) (see appendix B).
- Overrun was determined according to method of Jitjaroen (1999) (see appendix B).

A completely randomized design with 3 replications was used in this study to detemine the difference among mean values. DMRT was used for indicating the differences between treatment's means.

2. The stable foam from section 1 was extruded as spaghetti-like strips on aluminium trays through a 5 mm-diameter hole and air dried at 60 °C for 90 min. The

dried corn milk powders were scraped from the trays after drying and then kept in sealed aluminum foil bags.

The physical, chemical and microbiological qualities of the corn milk powders were defined in term of

- color values were recorded as L*, a* and b* coordinates by using a colorimeter.
- water activity (a_w) were determined by using an Aqualab Model Series 3.
- moisture contents were determined according to an AOAC official method no.925.45 (2000).
- rehydration was determined according to the method of Ratchaniyom (2002).
- solubility was determined according to the method of Sommanut (1997).
- dispersibility was determined according to the method of Sommanut (1997).
- hygroscopic was determined according to the method of Sommanut (1997).
- vitamin C was determined according to a titration method (a modified method from an AOAC official method no.967.21, 2000 and Rattanapanon, 2001).
- carotenoid was determined according to a spectrophotometer method (a modified from an AOAC official method no. 941.15, 2000).
- microbial analyses for the total microbial count and yeast and mould were determined according to methods published by Robert *et al*. (1995).
- yield (%) were determined according to the method of Sommanut (1997).

A completely randomized design with 3 replications was used in this study. DMRT was used for indicating the differences between treatment's means.

3.2.2.3 A Study of suitable temperature and time of drying condition in a production of corn milk.

Drying temperatures at 60, 70 and 80 °C were studied to produce corn milk powders. Samples of corn milk powders were collected every 10 min during drying processes to determine their moisture contents. The amount of the collected samples was about 5 g. From the results of these moisture contents, corn milk powders that had a moisture content of 5 % or below were selected for further studies (Anonymous, 2002). These samples of corn milk powders were evaluated for their physical, chemical and microbiological qualities.

The physical, chemical and microbiologycal qualities of the corn milk powders were defined in term of

- color values were recorded as L*, a* and b* coordinates by using a colorimeter.
- water activity (a_w) were determined by using an Aqualab Model Series 3.
- moisture contents were determined according to an AOAC official method no.925.45 (2000)
- rehydration was determined according to the method of Ratchaniyom (2002).
- solubility was determined according to the method of Sommanut (1997).
- dispersibility was determined according to the method of Sommanut (1997).
- hygroscopic was determined according to the method of Sommanut (1997).
- vitamin C was determined according to a titration method (a modified method from an AOAC official method no. 967.21,

2000 and Rattanapanon, 2001).

- carotenoid was determined according to a spectrophotometer method (a modified method from an AOAC official method no.941.15, 2000).
- microbial analyses for the total microbial count and yeast and mould were determined according to methods published by Robert *et at*. (1995).

A completely randomized design with 3 replications was used in this study. DMRT was to determine the difference among mean values.