

#### 4. Chip & Pellet

Due to their high perishability, fresh roots can be readily transformed into the dried product, called dried chips. Typically, chip yards are in close proximity to cassava growing areas so that roots are transferred at the lowest cost. Dried chips can be produced simply at a household level or at an industrial scale by mechanized process. In large scale production, fresh roots are loaded to the hopper of the chopping machine and chopped into small pieces or chips. Optionally, in some large scale processors producing premium quality chips, the removal of sand and soils is undertaken prior to root chopping, by adapting the machine of cassava starch process. Once chopped, the chips are then sun-dried on a cement floor. Chips are spread to a specific density and during drying, which typically requires 2-3 days, chips are turned over periodically, ensuring effective and uniform drying in order to obtain specified moisture contents. Too high moisture content in the finished product leads to inferior quality and can cause problems during chip storage in the warehouse. It is more difficult to process dried chips during rainy periods. Before rain, chips must be quickly piled up and covered with plastic sheets. This prolongs the time required to properly dry the chips and accordingly results in lower chip quality. The conversion of chip is approximately 2.5 kg of fresh roots to 1 kg of dried chips at 14% moisture content.

Thailand is a major exporter of cassava chips with the export volume in 2014 around 7 million tons. The major importer of Thai cassava chips is China. According to Thai Industrial Standard Institute (TISI) dried chips must contain less than 14%, 5% and 3% of moisture, fibre and sand, respectively. In addition, the chips must contain no foreign matter and living insects and present unusual colour, unusual odour and moulds. In 2002, a standard for cassava products was developed by the Ministry of Commerce with the additional criteria of starch content higher than 65% (on weight basis) when measured with the polarimetric method. A specification for premium cassava chips was also announced by Ministry of Commerce, having contents of moisture, fibre and sand less than 13%, 4% and 2.0%, respectively and starch content greater than 70% (by weight). Premium chips are preferred in animal feed and the ethanol industry due to lower sand content.



(a)



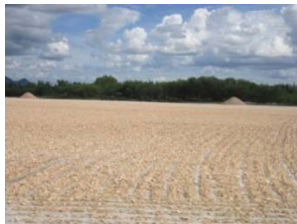
(b)



(c)



(d)



(e)



(f)



(g)



(h)

Process of making dried cassava chips: (a) Roots delivered to a factory, (b) Removal of dirt and sand, (c) Dirt-free roots, (d) Root chopper, (e) Sun-drying of chips and a stack of chips with a plastic cover, (f) Turning chips over, (g) Chips in a warehouse, (h) High quality cassava chips.

### Thai standard for cassava chips and premium cassava chips

	Cassava chips	Premium cassava chips
Starch (%w/w, minimum)	65	70
Fibre (%w/w, maximum)	5	4
Moisture (%w/w, maximum)	14	13
Sand and soil (% w/w, maximum)	3	2
Unusual odour or colour	No	No
Spoilage or moulds	No	No
Living subjects or insects	No	No

Source: Department of Foreign Trade, Ministry of Commerce, Thailand

Chips are also sold to pelletizing manufacturers. The development of this product was stimulated by a need to improve the uniformity in shape and size of cassava chips required by the compound feed producers/users. In addition, during transportation, loading and unloading of chips, dust generation caused serious air pollution, placing pressure on the importers in Europe to improve the nature of cassava products handled by the ports. Production of pellets involves pressing chips and extrusion through a large die. The heat and moisture in the chips helps in the formation of a pellet-like shaped product, known as a soft pellet. Later, the process has been developed by grinding chips followed by steam extrusion; this creates strong pellets upon cooling, known as hard pellets.



Chip grinding



Extrusion



Cooling



Storage

Process of making cassava pellets