

## **OMAN GREEN AWARDS 2011**

### **NOMINATION FORM**

**Instructions for completing the nomination form:**

1. Please use a separate Nomination Form for each award category.
2. You may attach extra paper as necessary
3. In the event you attach photographs, Statistical Tables and Reports to support your nomination they should be clearly labeled and marked
4. Please note that it is mandatory to provide two independent referees for the Nomination to be considered.

**Organization Details:**

*Organization Name*            Sultan Qaboos University

*CR No.*

*Organization Type (Business/NGO/Gov)*        GOV

*Website*    SQU

*Location /Address*                                        Al-khoud 123, Muscat , Oman

**Award Category**

**5. Green Research Award**

**Project Details:**

*Project Title*    Design construction and performance evaluation of a solar tunnel dryer in drying dates and fishes in Oman

*Location of Project*                                        Agricultural Experimentation Station (AES) of SQU

*One Line Description of Project*                        The solar tunnel dryer can be used by the rural farmers to dry about 200 kg of freshly harvested dates per batch within less than two days while maintaining its all qualities instead of drying it for 7-10 days in open air natural sun drying while deteriorating its qualities.

**Effectiveness**

*What were your goals?*                                        To dry about 200 kg of dates per batch within 2 days using solar tunnel dryer while maintain its qualities, and also to dry around 100 kg of fishes per batch within 2-3 days

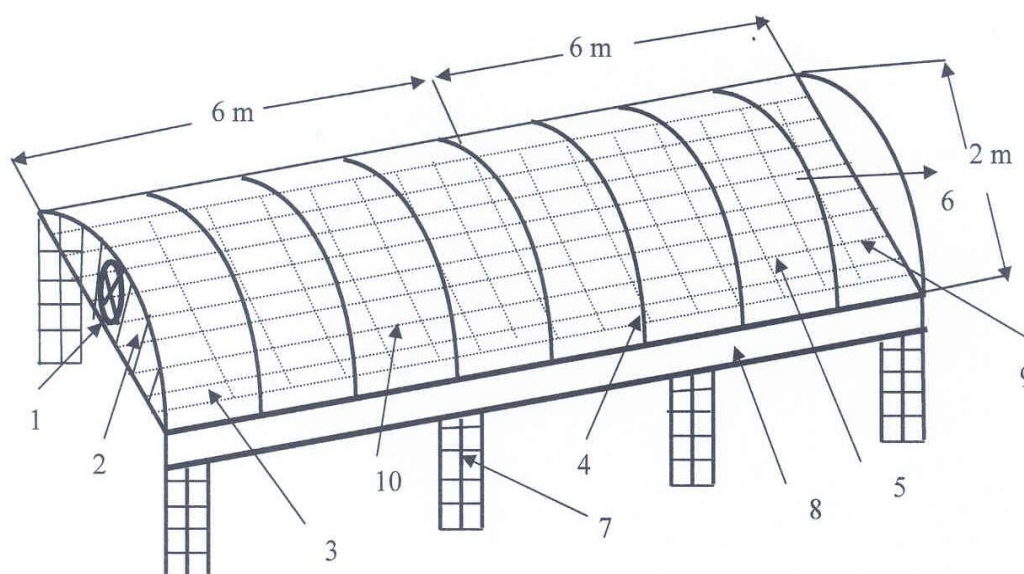
*How have you measured your success?* It was possible to reach the temperature within 40-65°C inside the tunnel while the air flow rates was 0.2 m/s thus it helped to dry about 200 kg of dates within less than 2 days. It was also possible to dry fishes about 50-100 kg per batch. A simple economic analysis has shown that from a tunnel base of drying area 12 m<sup>2</sup>, a medium size farm holder having 150-200 dates trees can earn an additional OMR 1000 per season from the dried dates instead of selling it as freshly harvested products.

### **Innovation & Creativity**

*How were innovative methods, strategies or ideas applied?*

Taking into consideration the dates harvesting capacities and the land-holding capacities of the marginalized rural farmers in Oman, a 12 meter long and 2 meter width tunnel with collector and drying area of 12 m<sup>2</sup>, respectively, was designed and constructed to dry about 200 kg of freshly harvested dates per batch. The lightweight aluminum frames were used as the upper structure of the half-circle tunnel to support the transparent plastic sheet. The base of the tunnel was made of wooden frames. The entire tunnel was placed about 700 mm from the ground surface on concrete blocks sub-structures in an open area of Agricultural Experimentation Station, Sultan Qaboos University. The solar radiation passes through the transparent cover and makes the air hot inside the nearly air-tight tunnel, particularly in the collector portion due to the presence of black surface flat collector (absorber plate). A solar powered fan (40 W) was used to force the hot air from the collector section of the tunnel to the dryer section over the product to be dried. No load tests (without product) were conducted during June-August 2008. It was found that the ambient temperature at no load condition could be easily raised to 45-60°C inside the dryer, which was above 5-20°C of the ambient air temperature, while the average air flow rate was 0.6 m/sec inside the tunnel. About 18 MJ/m<sup>2</sup> of solar energy was possible to harvest and trapped inside the collector of tunnel for the drying period of 10 hour per day.

Two tests were conducted with freshly harvested dates. First test was done with 190.5 kg of freshly harvested dates during July 27-28, 2009. In this test half of the tunnel base was used as dryer and the remaining half was used as a collector. The moisture content of the dates was reduced from 32.8 to 17.8 percent wet basis within three days (20 hours). The average day time temperature and relative humidity of the drying air in the collector region of tunnel were, respectively, 52.0°C and 34% while the ambient conditions were 36.2°C and 55.0%. The drying was much faster in solar tunnel dryer than the natural open air drying. It was found that two days (20 hours) was sufficient to reach safe moisture content level (18.0% wb).



**Fig. 1** 1- Air inlet to the collector, fan, 2- South side wooden cover, 3- Collector part ( $12 \text{ m}^2$ ), 4- Lightweight aluminum frame, 5- Dryer part ( $12 \text{ m}^2$ ) 6- Air outlet from the dryer, 7- Concrete block sub-structures, 8- Wooden frame to support bends and base of the tunnel; 9- Metallic wire mesh net over wooden base in the dryer part, 10- Absorber plate (black painted metallic sheet over wooden base, not visible in this Fig.  $12 \text{ m}^2$ )



Fig. 2. A solar tunnel dryer under construction



Fig. 3. A complete solar tunnel dryer (under operation-solar panel is used to supply power to the dryer fan)

The second test was conducted with 135.8 kg of dates using splitted collector areas and drying areas instead of continuous areas of collector and dryer during August 10-11, 2009. The test was conducted with 135.8 kg of freshly harvested dates only because of insufficient supply. The tunnel base were divided into three equal collector areas ( $2 \times$



2 m) followed by three equal drying areas alternatively starting from the air inlet side of the tunnel. This time two fans were used each of having capacity of 40 watt, one at each side of the tunnel. The fan at the north side of the tunnel was forcing ambient air inside the tunnel and the other one at the south side was taking air out of the tunnel. The moisture content of the dates was reduced from 40.8 to 13.8 percent wet basis within two days (24 hours). This indicated that one day (10 hours) was sufficient to reduce moisture content level of 135.8 kg dates to safe moisture level. The average temperature and relative humidity of the drying air inside the tunnel were, respectively, 50.3<sup>0</sup>C and 41.1% while the ambient conditions were 41.0<sup>0</sup>C and 55.0%. The improvement in the quality of dates in terms of color, flavor, and taste and food value was distinctly recognized in both tests.

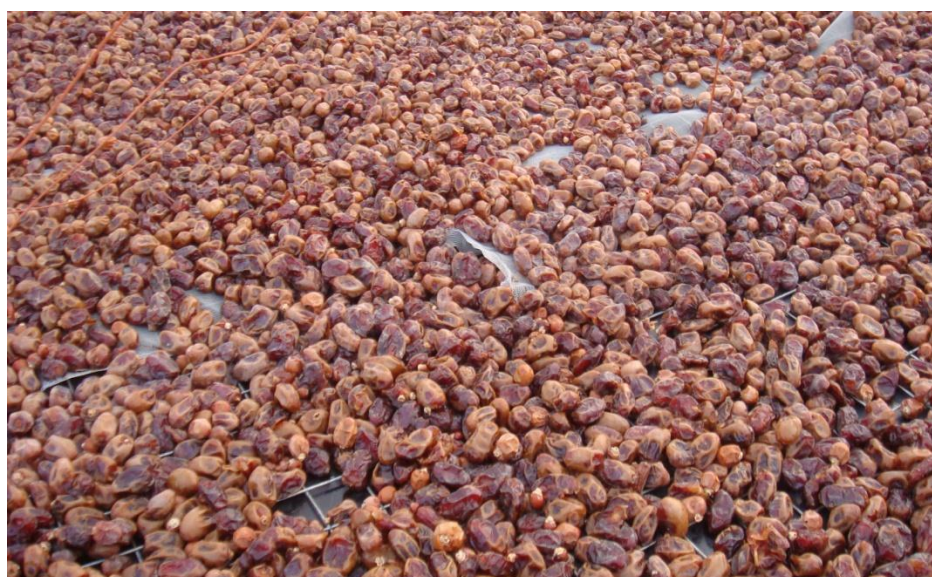


Fig. 4. Dried products in a solar tunnel dryer (very attractive colour)

A test with 50 kg of freshly harvested sardine fish was also conducted during August 19-21, 2009. This time two fans were used as in second test with dates. The moisture content of fish was reduced to 11.3% (w.b.) from original 66.4% (w.b.) within 3 days (48 hrs). It indicated that three days was sufficient to reach the safe moisture content level (16% w.b.). The average temperature and relative humidity of the drying air in the collector portion of tunnel were, respectively, 50.0<sup>0</sup>C and 33.7% while the ambient conditions were 41.0<sup>0</sup>C and 47.1%. The improvement in the quality of the dried fish in terms of color and food value was distinctly recognized.

The 40-65 <sup>0</sup>C drying air temperature inside the tunnel can be attained under most arid climatic conditions. Thus neither additional capital investment nor operating cost is necessary for the supplemental heating of drying air. The main advantages of the solar tunnel dryer is that it can be easily built by local technicians using locally available materials, and less loss and wastage will occur than when dates and fishes are improperly dried in the sun or too rapidly dried with highly heated air.

The use of this solar tunnel dryer, in rural areas of Oman where electricity is not available, should then encourage the harvesting of dates with moisture contents as high as 40% (w.b.) to minimize harvest shatter losses.

### **Impact**

*How has the project/initiative/work motivated others to contribute to a greener Oman*

The short term goals of solar tunnel drying is that it will be practiced on small to medium sized land holding in remote rural areas for drying dates, either as subsidiary or main occupation. This will also help the rural farmers to get higher prices of their products in the off season.

The long-term goal will be to establish commercial solar drying industry in Oman to improve the quality of the dried product and sustainable conservation of environment.

**Originality and Leadership**

How has the nominee demonstrated vision, foresight and persistence?

This is the first time in Oman that this particular solar tunnel dryer was designed, constructed using locally available material and tested successfully in drying of dates and fishes.

**Continuity & Sustainability**

How sustainable is the initiative carried out? The same solar tunnel dryer can be used to dry other easily perishable agricultural products like tomatoes, bananas, cucumbers etc. Thus it is environmentally sustainable.

Explain how it will be effective in the long term The long-term goal will be to establish commercial solar drying industry in Oman to improve the quality of the dried agricultural products and sustainable conservation of environment using this green technology.