

Date Palm Research Center of Excellence King Faisal University

P.O. Box 400
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Saudi Arabia

Research Program

Date Processing and Value-added Technologies (DPVAT)

Duration: Five Years

Funded by: Ministry of Higher Education, and KFU

Starting date: 2015



Date Processing and Value-added Technologies (DPVAT)

Overview



The date palm, *Phoenix dactylifera* L., is one of most cultivated palms in arid and semi-arid regions of the world. About 90 million date palm trees are grown in the Arab world with an annual production of 5694213 tons which 75% of the world production (FAO Statistics Database, 2012). Saudi Arabia is the third main date palm producers in the world with an annual production of 1,050,000 tons from 1600,000 ha, that represents 13.9% of the global date production. About 14.12% (140,000 tons) of the produce is being exported with safety tag such as pesticide residue-free (Ministry of Agriculture, 2011).

The date fruit pulp is rich in phytochemicals such as phenolics, sterols, carotenoids, antho-cyanins, procyanidins, and flavonoids. The observed pharmacological properties may be attributing to the presence of a high concentration of minerals and various other phytochemicals of diverse chemical structure. Therefore, information about human health promoting possibilities in date products might encourage using them as ingredient in functional foods.

Scope



There is substantial scope for the emergence of new vital industries in the date palm growing countries towards efficient and effective utilization of date palm fruit waste management. Further, there is also scope for socioeconomic and rural development in those countries where date palm is cultivated on large scale through effective management of date palm fruit production.

This strategy will expose us to the most recent advances in the science and emerging technologies (thermal, non-thermal, nanotechnology and advanced material technology) relevant to food processing, preservation, packaging and manufacturing. The content will be delivered in such a way that researchers will continuously develop their innovative capability and theoretical understanding of the modern

Innovation researches to produce eco-safety, economically and

commercialize by-products with add values.

concepts and create eco-safety research with economic value to maximizing benefits of date palm fruits and date palm biomass with value added.

Vision

Leadership and excellence in scientific research studies contributing to dates fruits and palm by-products manufacturing.

Mission

Adopt and improve advanced research technologies and excellence innovations to maximize the benefit and adding values of dates and date palm by-products

Research Strategy

The program research strategy depending on applicable researches to get real products for adding economical and commercial values of date palm using modern technologies.

Program objectives

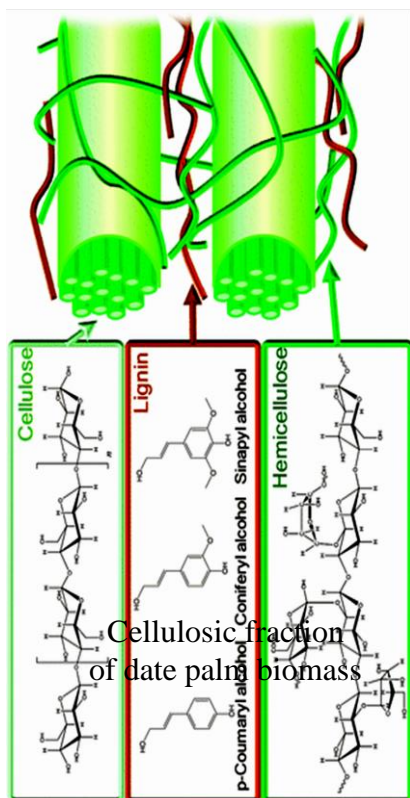
The program is aiming to:

1. Perform studies and applied research for date palm processing sector in the Kingdom of Saudi Arabia to achieve economical and commercial adding values of dates and its derivatives industry.
2. Coordination with research centers and the relevant authorities to contribute the development of a comprehensive strategy for the dates industry and date palm by-products.

Program components

1. Innovative tools, techniques, and technology transfer.
2. Training and competence development of postgraduate students and research fellows.
3. Establishing database and date palm expert system.
4. Publication of research outcomes and share of scientific knowledge with the date palm community.

Research themes and subthemes



A. The main research activities areas of the (DPVAT) program fall into the following:

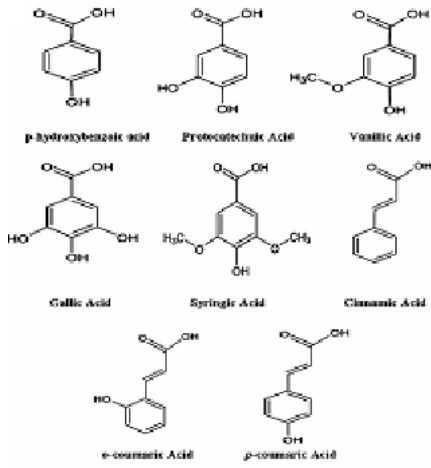
1. Date fruits biotechnology.
2. Microbial and insects disinfestations control in dates.
3. Packaging techniques to preserve dates quality.
4. Development of new economically value-added products from dates.
5. Utilizations of date palm tree residue biomass or wastes.
 - Recycling of cellulosic material of date palm from frond, bunch, leaf, stem, trunk and seed as date palm wastes to produce an economical and commercialized products' "by-product" with add values.

B. Determine main chemical constituents of date palm genotypes grown in KSA:

1. Main chemical constituents in date fruits are carbohydrates, dietary fiber, enzymes, protein (total and fractionated amino acids), fat (total and fractionated fatty acids), minerals, vitamins [vitamin C (ascorbic), B₁ (thiamine), B₂ (riboflavin), A and nicotinic acid (niacin)], phenolic acids, carotenoids and organic acids.
 - The important thing here is to get all adding values of dates and date palm biomass qualitatively and quantitatively. Furthermore, determining changes of all chemical constituents of main date cultivars, date growth stages, and durable storage time.
2. Phytochemical compositions in date fruits are responsible for their bioactivities, providing many potential health benefits such as antioxidant activity, cholesterol-lowering properties, prevention diseases of cardiovascular, diabetes ... etc. Phytochemical compositions include carotenoids, polyphenols especially phenolic acid, isoflavons, lignin, flavonoids, tannins and sterols.
 - Here important thing is to find the new structure or new kinds of phytochemical compositions from date palm.

C. Confirm nutritional and medicinal values of date palm *in-vitro* and *in-vivo* and identify the relationship between chemical constituents and medicinal values of date palm:

1. Date palm extracts show some activities such as antioxidant activity, anti-inflammatory activity, gastrointestinal-protective activity, anti-mutagenic activity, hepato-protective activity, nephro-protective activity, gonadotropic activity, prevention and control of cancer, diabetes, therapy of and cerebrovascular diseases, heptocellular carcinoma ... etc.
 - These activities need to be studied further *in-vitro* and *in-vivo*
2. The relationship between chemical compounds and medicinal values of date palm needs to be built. Mechanisms of action for these compounds in date palm providing the benefits will be studied.



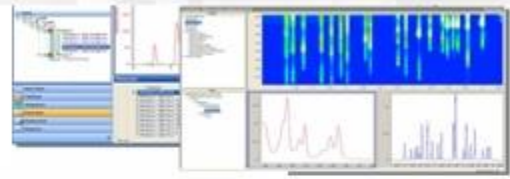
Structures of some phenolic acids present in dates

D. Investigate nutritional and medicinal values of date by-products, and develop new products:

1. Develop value-added products from date palm by liquid and/or solid state fermentation technology.
 2. Enhance nano additives production from date palm (e.g. nano-dietary fiber and antioxidants-rich nano-emulsion).
- Here important thing is to develop value-added products from date palm using advanced processing technologies by biotechnology, polymer and nanotechnology.

Research Infrastructures

To run advanced processing technologies of date palm program, the program has two modern labs:



Analytical Chemical Lab



Post-Harvest lab



In addition, the program have a modern pilot scale dates processing facility with dates quality control lab, cold and freezing storage rooms.

There are also two fermentation labs with a pilot scale fermenter and pilot scale ultra-filtration unit (established in Faculty of food and Agricultural, King Faisal University).

Fermentation Lab

Our labs fully integrated with other DPRCE labs and King Faisal University's wider facilities.



Program Organization and Management

The program includes a set of research projects based on the themes and sub-themes of strategic significance, which achieve specific research objectives from a whole standpoint. A specialized consultative committee and a peer review board will be constituted to assessment the project proposals and monitor the progress of the program.

Strategic Significance

Date palm fruits extract is rich in sugars, minerals, vitamins, and other pharmaceutical secondary constituents. Innovative research concept will lead to economic and commercial pharmaceutical products with added- value from dates and its by-products.

There is only a few scientific work has been done on date palm tree by-products. There might be a strong need for conducting a detailed analysis for fibrous raw materials in order to provide recommendations on product range, appropriate production processes, with the focus on technology transfer.

The Program Research Plan (2015-2019)

The activities of the program will fall into two categories:

1- Area of greater significance

The focus will be on the fruits of the date palm pharmaceutical properties with added- value, according to the schedule follows .:

Sr. No.	ACTIVITY	Years 1 st – 3 rd											
		1 st			2 nd			3 rd					
1	Preliminary extraction of water-soluble date palm fruits contents using different extraction method.	*											
2	Optimization of extraction method toward high yield of biomolecule and related bioactive constituents.		*										
3	Isolation of different biomolecule and related bioactive constituents.			*									
4	Structure elucidation of isolated compounds.				*								
5	Mass spectrum fingerprinting of extracts.			*	*								
6	<i>In vitro</i> assay of antioxidant activities for biomolecule – rich extract of palm date fruit.				*	*							
7	<i>In vivo</i> assay of antioxidant activities for biomolecule – rich extract of palm date fruit.					*	*						
8	Extract dose adjustment for maximum <i>in vivo</i> antioxidant activity.						*	*					
9	<i>In vivo</i> disease protective activity for biomolecule –rich extract of palm date fruit.						*	*					
10	<i>In vivo</i> anticancer activity for biomolecule -rich extract of palm date fruit.							*	*				
11	Assessment of diseased organ cyto-toxicity of palm date fruit biomolecule -rich extract.								*				
12	Economic evaluation of biomolecule -rich date palm products.								*				
13	Formulation and stability studies of final products							*	*	*	*	*	*
15	Bioavailability studies (Clinical Studies).								*	*	*	*	*
14	Estimated budget	1.15 million SR											

2- Secondary area of potential significance

The research will focus on add value of date palm cellulosic, fibrous, biomass and wastes.

Team members of the program

Research Staff

Hisham Abd El-Monem Mohamed. (Ph.D., **Biochemistry and Plant Biotechnology**)

Technical staff

Waleed Alsenaien. (B.Sc. , **Food Science and Nutrition**)

Contact

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Research staff CV. Synopsis

PERSONAL DATA

Name: Hisham Abd El-Monem Mohamed

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Nationality: Egyptian

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Marital Status: Married with three children (two boy and one girls).

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EDUCATION BACKGROUND

1996: **B.Sc.** in Agriculture Cairo University of Egypt.

2001: **M.Sc.** in Agriculture Cairo University of Egypt (Biochemistry and specific in Plant Pathology).

2007: **Ph.D.** in Agriculture, Cairo University of Egypt (Biochemistry and specific in Plant Pathology).

RESEARCH TOPICS AND AREAS OF INTEREST

- Developmental biology, Biotechnology and Plant disease (Pathogen & Host relationship and interaction);
- Developed several biological preparations for soil borne pathogens attack root system to be used in plant protection programs instead of chemicals;
- Pest management in orchard systems, preparing natural pesticide to control pests;
- Mass spectroscopy and fingerprint for new edit natural compounds;
- Recycling of agricultural wastes to add values products;
- Recently, processing of date palm and date palm by-products using advanced technology (Nanotechnology, Biotechnology and Advanced Materials).

RECENT PUBLICATIONS

1. **Mohamed, H.A.; N.F. Nasr and I. Abdelkreem, Khadega. (2015).** Management of tomato damping off disease caused by *Fusarium oxysporum* and *Rhizoctonia solani* using chemical and biological degradable olive mill waste water. *Egyptian Journal of Biological Pest Control*, 52(2): 401-411
2. **Abeer, R.M. Abd El-Aziz; Monira R. Al-Othman; Mohamed A. Mahmoud and Hesham A. Mohamed (2014).** Xylanase Production by *Aspergillus niger* KSU 23 using Corn Cobs. *JOURNAL OF PURE & APPLIED MICROBIOLOGY*,, 8 (Spl. Ed^{nd2}): 161-166.
3. **El-Gremi, Sh.M.A.; K.E. Ghoniem; H.A. Mohamed and S.M.H. Kamel (2013).** Mode of Action of *Bacillus pumilus* in Suppressing *Pseudoperonospora cubensis* (Berk and Curt) Rostow, the Pathogen of Downy Mildew of Cucumber. *Egyptian Journal of Biological Pest Control*, 23 (1): 71 – 77.
4. **Ismail A.S. Rashid, H.A. Mohamed, Samir S.A. Badawy and M.I. mohamed (2013).** Controlling of fungal and aflatoxin contamination on peanut by using harvest date and some bioagent.. *Journal of Biological Chemistry and Environmental Science*, 8 (4):129-142.
5. **Noha, F. El-Badawy, S.R.E. Abo-Hegazy, M.M. Mazen and H.A. Mohamed (2012).** Evaluation of Some Faba Bean Genotypes against Chocolate Spot Disease Using CDNA Fragments of Chitinase Gene and Some Agronomic Methods. *Journal of American Science*; 8 (8): 241-250.
6. **Mohga A. El-Tahlaway; Samah, A. Mokbel and A.M. Mandour and H.A. Mohamed (2012).** Effect of environmental factors on *Peanut mottle virus* infection and population of insects on Lentil in Egypt. *Egyptian J. Virol.*, Vol. 9:110-115.
7. **Abdelnabby, H.M.; Mohamed, H.A. and Abo Aly, H.E. (2011).** Nematode-antagonistic compounds from certain bacterial genera. 3^{ed} International Conference of microbiology, Banha Univ., 11-13 October, 2011; *Egyptian Journal of Biological Pest Control*, 21 (2): 209-217.

8. **Mahmoud, E.Y.; Ata, A.A. and Mohamed, H.A. (2011).** Efficiency of some growth regulators as inducer resistance factor for controlling peanut damping-off, wilt and root rots diseases. *Fayum j. Agric Res. & Dev.*, Vol. 25, (2): 152-163.
9. **Kararah, M.A., K.A. Abada, H.A. Mohamed and Y.N. Taif (2011).** Effect of some bio-agents, plant extracts and gamma irradiation on the deterioration and fumonisin production in stored maize grains. *Egypt. J. Phytopathol.*, 39 (2): 173-192.
10. **El-Sayed, A.B.B.; Mohamed, H.A. and Abd El-Kader, M.H. (2010).** impact of some essential oils and their combinations with vitavax-theram fungicide on controlling Sclerotium root-rot of sugar beet. *J. Agric. Sci. Mansoura Univ.*, Volume 1 (8): 647 - 663.
11. **El-Shabrawi, M.E.; El-Sayed, A.B.B.; Mohamed, H.A. and Sadoma, M.T. (2010).** Role of Ferulic Acid in Resistance of Maize Plants to Infection with Ear-Rots and Mycotoxin Production. *Egypt J. of Appl. Sci.*, Volume 25 (12B): 493 - 506.
12. **Mohamed, H.A.; El-Sayed, I.H. and Moawad, M. (2010).** Protective effect of Nigella sativya seeds against dimethylaminoazobenzene (DAB) induced liver carcinogenesis. *Nature and Science*, 8 (6): 80-87.