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Article

A Scientometric Analysis of Studies on the Effects of the Date palm (*Phoenix dactylifera*) Fruit on Human Health

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Abstract— **Background/Aims: Date palm, *Phoenix dactylifera*, is mentioned 27 times in the Holy Quran and is considered a prophetic food. Islamic scripture together with Jewish and Christian holy texts refers to date palm fruit as having many beneficial effects on health including medicinal properties. This study aims to characterize scientific studies on date palm fruit relating to human health in published scientific literature.**
Methods: Five major scientific databases of published literature were searched for papers relating to the effects of date palm on human health. A scientometric analysis was then performed on the studies obtained.
Results: Analysis of 270 relevant papers revealed a lack of human subject studies despite numerous papers reporting beneficial nutritional properties and promising results from animal studies. Saudi Arabia leads global research output on this topic.
Conclusion: Further research should be supported to advance knowledge useful to local populations, especially in Islamic countries where the widely accessible date palm fruit can confer many potential health benefits.

Keywords— **Date palm; health; *Phoenix dactylifera;* scientometric.**

I. Introduction

The fruit of the date palm, Phoenix dactylifera, is widely consumed by populations in vast areas of Asia and northern Africa. Its importance as a nutritious food source has been well documented going back several millennia. Alongside numerous historical references, there are many references to date in Judeo-Christian texts as possessing health preservation and even therapeutic properties. The Holy Quran mentioned the date palm fruit 27 times under several names and referred to similar beneficial properties conferred by the fruit (Abdul Baqi, 1994; Al-Bukhari, 2000; Al-Sijistani, 1985; Al-Razi, 1992).

Considering the importance of the date palm, there has been a steadily increasing amount of scientific research relating to the fruit. This trend has been established by a previous scientometric study published in 2014 (Alhaider et al, 2014) that analyzed global research output relating to date palm between 2000 and 2011. The study obtained and characterized 1376 scientific articles from Scopus.

The regions where the date palm fruit is consumed also carry amongst the heaviest burden of global disease and contain many impoverished populations (Bouaziz et al, 2008). Many nutritional studies have shown that the accessible and cheap date palm fruit possesses high energy content and also provides essential vitamins and minerals (Al-Turki et al, 2010; Hong et al, 2006). Furthermore, it also contains many compounds that preserve and benefit health such as phenolics, flavonoids, sterols and procyanidins (Khanavi et al, 2009).

Notwithstanding the published nutritional studies, the body of scientific studies investigating the health effects of date palm fruit appears to be small and poorly organized. This is incongruent with revealed Islamic knowledge from the Quran and the Hadith, as well as from Judeo-Christian texts that refers to the date palm fruit as having potential healing properties. Therefore, we aimed to characterize and quantify the scientific research relating to the effects of date palm on human health.

The main objective of this study is to perform a scientometric analysis of the current published research that investigates the effects of the date palm fruit on human health.

II. Materials and Methods

Five main databases were systematically searched for studies investigating the effects of date palm fruit on human health outcomes. These were Embase, Medline, Scopus,

ProQuest and Ebscohost. The databases were searched consecutively. Limited hand searching was also conducted once the 5 databases had been searched. Each index database was accessed via their respective gateways or portals. The following search terms were used individually or combined to conduct the search: Individual search are as follows 'date', 'palm', 'phoenix', 'dact*l*fera', combine words ('date' and 'palm'), correlation of ('date' and 'palm') or 'phoenix' or dact*l*fera. There was no year limit for the data searched.

In order to ensure the relevant papers were selected, the title and abstract of each study obtained while searching were reviewed in two stages. The first stage involved independent assessment by at least two reviewers to determine eligibility (TSBAR, ABS, MBI) while the second stage involved confirmation from an expert assessor (KBA, MDBMR, KNBNA). Studies on P. dactylifera using the flesh, pulp, pits or kernel were included. However, studies that used parts of the plants other than the fruit were excluded. To be eligible, the study must have measured parameters or outcome that relates to human health. Only papers written in English were chosen to allow adequate analysis

Full papers were obtained for all eligible studies. The selected citations and their full study reports were managed using Endnote (Endnote X7). Scientometric analysis was then performed on the compiled database.

III. Results

Initial searching through the five databases yielded a total of 8390 citations of potentially relevant studies. The citations included articles published from the year 1966 until 2015 over a duration of 49 years.

Following the two stages of filtering, 270 eligible studies were identified using the inclusion and exclusion criteria listed previously. The publication output of the human health effects of date palm has increased rapidly every year from 1966 to 2015. After eliminating duplicate papers from each database, the total number of papers found first from each database is shown in Table I.

TABLE I
TOTAL NUMBER OF PAPERS BASED ON DATABASE SEARCHED

Database	**Total Papers**	**Percentage [%]**
Embase	66	24.4
Medline	60	22.2
Scopus	108	40.0
ProQuest	13	4.8
Ebscohost	15	5.6
Other Sources	8	3.0
Total	270	100

Scopus indexed the highest total number of published reports with a total of 40% of all included studies. The second highest database was Embase with a total percentage of 24.4%, followed by Medline with 22.2%, Ebscohost with 5.6% and ProQuest with 4.8%. The studies on date palm fruit were divided into two main groups that were interventional and non-interventional studies. There were 98 (36.3%) interventional studies where subjects including human, animal and microorganisms were administered date palm fruit and outcomes relevant to human health were measured. Non-interventional studies totalled 172 (63.7%). These were studies where date palm fruit was studied to assess their potential effects on human health.

Each group was further classified based on the subject of the study, as shown in Table II. Most papers seemed to be nutritional analyses of date palm fruit with well over half (56.7%) of all the studies being in this category. Interestingly, the second most frequent study was interventional animal disease model studies were date palm fruit was fed or administered to the animal subjects.

TABLE III
STUDIES CATEGORISED TO TYPE AND SUBJECT

Intervention		**Non-intervention**	
Categories	Total	Categories	Total
Human	9	Nutrition	153
Animal	58	Toxicology	9
Cell / Tissue / Blood	9	Allergen	2
Pathogen	22	Pathogen	6
		Miscellaneous	2
Total	98	Total	172

The country contributing the most published studies was Saudi Arabia with 43 (15.9%) of the total papers, seen in Table III. This was followed by Tunisia with 32 papers (11.9%), Iran with 27 (10%) and others. Thus the Middle East and northern African regions contributed the most towards global research output on health effects of date palm. Interestingly the USA and the UK also contributed significantly to global research on date palm fruit health effects with almost 10% of the total studies.

TABLE IV
COUNTRY OF ORIGIN FOR STUDIES

Country	Total Number Papers Published
Saudi Arabia	43
Tunisia	32
Iran	27
Egypt	18
United Arab Emirates	16
Algeria	15
Oman	14
United States of America	13
United Kingdom	11
India	10
Pakistan	9
Jordan	7
France	5
Nigeria	5
Greece	4
China	4
Bahrain	3

Israel	3
Japan	3
Kuwait	3
Libya	3
Malaysia	3
Morocco	3
Canada	2
Spain	2
Sudan	2
Yemen	2
Others	8
Total	270

IV. Discussion

Although the number of date palm studies relating to human health appears to have increased over the years, the studies are relatively few. We found only 270 reports on studies of date palm fruit relating to human health after searching five major databases. Correspondingly, a previous scientometric study found that global research output on Phoenix dactylifera consisted of 1376 papers (Alhaider et al, 2014). Considering that this previous study included vast numbers of botanical and agricultural studies, this lends further support to the apparent low numbers of studies that investigate date palm fruit as a health food.

Most of the studies were first found in index databases of Scopus and Embase followed by Medline. This further supports the idea that relatively little attention is given to studying date palm fruit in relation to health as Medline is regarded as the eminent index database of healthcare research.

The findings showed that only nine published papers were studies using human subjects. This minuscule number of human subject studies was surprising considering these studies would provide the most usable evidence in elucidating health effects of date palm fruit. Furthermore, human subject studies would not require large resources since the date palm fruit is abundant and easily obtained globally. As a commonly consumed food it also presents little risk that would hinder human subject studies.

Findings from the few human subjects' studies have shown that date palm fruits may confer important health preservation and therapeutic benefits. The human studies suggest that date palm fruit provides significant prevention of childbirth complications (Al-Kuran et al, 2011; Khadeem et al, 2007), anti-aging effect on skin (Bouaziz et al, 2008), a benign effect on glucose and lipid profile yet improves oxidative status in humans (Ahmed et al, 1991; Bauza et al, 2002; Rock et al, 2009).

There were relatively more studies using animal models of human diseases as subjects, as well as research on the effects of date palm fruit on pathogens relevant to human health. Many promising health effects of date palm fruit such as pro-fertility, anticancer, cytoprotective, anti-mutagenic, anti-oxidative stress, anti-diabetes, antihypertensive to name a few, were demonstrated by these studies (Agbon et al, 2014; Saafi-Ben Salah et al, 2012). The imperative should be to extend the investigations of these promising effects into human subject studies with the aim of providing solid evidence of the beneficial effects of date palm fruit.

The most numerous studies by far were nutritional analyses of date palm fruit in relation to human consumption. There have been several large reviews of the nutritional properties of date palm fruit (Mousavi et al, 2014; Rahmani et al, 2014; Vayalil, 2012) and the value of date palm fruit as a nutritious wholesome food is well established at this juncture. Many studies show that date palm fruit contains essential vitamins, minerals, antioxidants, phenolic compounds, flavonoids, phytochemicals and many other beneficial substances. This stands in contrast to the dearth of research on the nutraceutical and therapeutic effects of date palm fruit as previously mentioned. Considering that references in Islamic scripture and also previous Jewish and Christian text mentioned specifically on the medicinal potential of date palm fruit, further research should be performed to explore the medicinal effects of date palm fruit.

The majority of date palm fruit studies relating to health came from institutions in Islamic countries. Our finding that Saudi Arabia led the research output for health effects of date palm fruit was consistent with a previous scientometric analysis of global date palm research output overall in all fields of study (Alhaider et al, 2014). Our study reaffirms the very high research activity on P. dactylifera in Saudi Arabia, reflecting a national research priority on this prophetic plant. The origin of research activity also seems to correlate with the countries that produce the bulk of date palm fruit (FAO, http://www.fao.org/docrep/006/y4360e/y4360e00.HTM).

Almost 10% of studies came from the traditional leaders of world health research, namely the USA and the United Kingdom. In fact, the previous scientometric paper (Alhaider et al, 2014) found that if all fields of study were included, the USA came second behind Saudi Arabia in research output relating to P. dactylifera. Therefore, there appears to be significant research interest on date palm fruit even where there is limited or no production of the food.

Our study searched a wide range of index databases including five of the major databases containing healthcare publications the scientometric analysis was conducted. This gives additional weight to our study compared to previously published scientometric studies. Furthermore, the more focused nature of our study on research pertaining to human health provided useful insights on the characteristics of date palm fruit scientific studies with relevance to Islamic wisdom and references in the holy text. A limitation to our study might arise from the possibility of certain research papers being published in languages other than English, therefore being absent from our scientometric analysis. Another possible limitation can be expected from the current state of indexation of research literature whereby papers from the developed nations dominate the scientific space. Thus papers from countries where date palm is produced may not gain sufficient exposure compared to papers from the developed world. Nevertheless, our search has compiled numerous papers from developing and even low income countries. Scientometric analyses such as we have done can further highlight studies from developing countries, particularly in the Islamic world to advance scientific knowledge relevant to the local population.

V. CONCLUSIONS

In conclusion, our scientometric analysis of scientific studies on the health effects of date palm fruit has revealed important characteristics of the research activity on this prophetic food. There should be more human subject studies considering the growing evidence base of the beneficial health effects from nutritional analysis studies as well as potential medicinal properties from animal model studies using date palm fruit. Saudi Arabia currently leads the global research activity on this prophetic food, however there is research interest on health effects of the fruit of P. dactylifera worldwide. Further research on date palm fruit should be encouraged and supported considering the importance given to it by Islamic scripture together with the other Abrahamic religions.

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