TRADITIONAL CHEWING OF ARECANUT/BETEL QUID AND HUMAN HEALTH - A SURVEY REPORT

C.T. Jose[1], S. Keshava Bhat[2], K.P. Chandran[3], S. Jayasekhar[3] and Ananda Gowda[1]

Abstract

Arecanut is the fruit or seed (endosperm) of an oriental palm called *Areca catechu* L. Though this palm is cultivated in several tropical and subtropical countries such as India, Indonesia, China, Myanmar, Bangladesh, Sri Lanka, Thailand, Bhutan, Malaysia, etc., India is the largest cultivator of this crop. This nut is the most common masticatory in the world especially in South and South East Asian Countries. The history of arecanut chewing is not of recent origin but goes back to thousands of years. Traditionally, arecanut is chewed along with the leaf of *Piper betle* and lime (calcium hydroxide). This mixture is commonly called as pan or betel quid. Later on, several other ingredients including tobacco are added and made into different forms of chewing mixtures and marketed in different trade names where neither the quality of the ingredients is known nor their names are properly disclosed. In the present study, a survey was conducted in certain arecanut growing districts of Karnataka and Kerala targeting only the traditional arecanut or betel quid chewers to find out the health effects of such chewing. Of the 917 people surveyed, 232 people were non chewers, 292 were chewers of betel quid without tobacco and 393 were chewers of betel quid with tobacco. Not much health variations were noticed except for tooth problems which were much less in betel quid (both without and with tobacco) chewers when compared to non chewers.

Introduction

Arecanut, an important commercial agricultural produce of India, is the seed or endosperm of a slender and tall oriental palm, *Areca catechu* L. of Palmaceae family (Ananda, 2004). This palm is also cultivated in several other South Asian and South East Asian Countries such as Indonesia, Myanmar, China, Bangladesh, Thailand, Malaysia, Vietnam, Philippines, etc. (Cheriyan and Manojkumar, 2014). In some regions of the world arecanut is also called as 'betel nut' as this nut is commonly chewed along with the leaf of *Piper betle* L., a tropical, evergreen, perennial vine of Piperaceae family. Arecanut chewing is an indigenous habit notably in Central, South, and South East Asia, and some South Pacific Islands. World Health Organization estimated that around 600 million people chew betel nut around the globe in some form or the other. It is an essential cultural and social tradition in several countries. It is perceived to have medicinal values; including oral hygiene, appetite as well as saliva production. It is a common practice to offer arecanut along with

[1] ICAR-Central Plantation Crops Research Institute Regional Station,Vittal, Karnataka
[2] Arecanut Research and Development Foundation, Varanashi Towers, Mission Street, Mangalore, Karnataka
[3] ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala

betel leaf to guests in important social gatherings, weddings and other religious events. This habit is widely accepted among all strata of society, including women and children.

There are differences of opinion on the risk/ benefits associated with arecanut chewing. India has the largest arecanut consuming population in the world. Arecanut chewing has wide-ranging social and cultural influences. Traditionally, betel chewing consists of arecanut wrapped with the leaf of *P. betle* smeared with slaked lime (calcium hydroxide). This mixture is called as betel quid. Although major contents of this quid are almost same in all preparations, the ingredients may vary according to the local customs and individual preferences. Tobacco is often added to the betel quid and sometimes other ingredients like cardamom, clove, menthol, aniseed, grated coconut, coriander, saffron, extracts of rose and jasmine are also added (IARC, 2004).

Since time immemorial, arecanut along with other products is being used for chewing throughout the world especially in Indian sub-continent and several parts of South East Asia as it is believed to be stimulatory and to have lots of medicinal properties (Aman, 1969). In India the use of arecanut has been quoted as early as 1300 BC by Sisu Mayana in 'Anjana Chaitra' (Bhat and Rao, 1962) and the practice of its chewing to 650 BC as mentioned by Magha in 'Shishupala Vadha' (Rao, 1982). In other countries such as Vietnam, the antiquity of arecanut goes back to Bronze Age (Oxenham *et al.*, 2002).

Arecanut has an important place in the ancient system of medicines in several countries such as India (Kirtikar *et al.*, 1918), China (Peng *et al*, 2015), Bangladesh (Rahmathullah *et al.*, 2009), Philippines (Tavera, 1901), etc. The World Health Organization (2009) has included areca palm as one of the medicinal plants of Philippines. Most of the folklore medicinal properties of arecanut are now validated with proper scientific data (Rashid *et al.*, 2015). It has antioxidant, anti-inflammatory and analgesic (Bhandare *et al.*, 2010), anti-diabetic (Anthikat *et al.*, 2014), hypolipidemic (Park *et al.*, 2002), antibacterial (Hazarika and Sood, 2015), anti-fungal (Anthikat *et al.*, 2014) anti- malarial (Jiang *et al.*, 2009), anti-viral (Anthikat and Michael, 2009), anti-HIV (Kusumoto *et al.*, 1995), treatment for AIDS (Vermani and Garg, 2002), anti-aging (Lee and Choi, 1999) treatment for Alzheimer's (Joshi *et al.*, 2012) and Schizophrenic patients (Sullivan *et al.*, 2000) wound healing (Azeez *et al.*, 2007), anti-ulcer (Anthikat and Michael 2011; Senthil and Hazeena, 2008), anti-migraine (Bhandare *et al.*, 2011), antihypertensive (Inokuchi *et al.*, 1986) antidepressant (Khan *et al.*, 2014), anti-allergic (Lee *et al.*, 2004), anthelmintic (Valenciano and Cotiwan, 1980), aphrodisiac (Anthikat *et al.*, 2012), anti-venom (Gupta and Gupta, 2013) hepatoprotective (Pithayanukul *et al.*, 2009), cytoprotective (Sazwi *et al.*, 2013), antitumorogenic (Kumari *et al.*, 1974) properties, etc. In China, as many as 30 medicines are being prepared using arecanut as one of the ingredients (Peng *et al.*, 2015).

Though arecanut has got all these beneficial properties, several researchers projected arecanut chewing as dangerous and even cause

cancer (IARC, 2004). Almost all studies were mostly based on the survey data considering several chewing products where arecanut is one of the components, but blamed only arecanut for all the ill effects. The adverse effects reported in association with arecanut chewing may be due to several other factors such as small sample size, the role of other ingredients used in the preparations of chewing products (especially in packed products such as pan masala, gutkha, khaine, etc.), the cumulative effects of all the ingredients, unusual methods of application, the quality (including contaminations and adulterations) of arecanut used etc. Most of the research publications which projected arecanut chewing as dangerous did not check for these factors (Keshava Bhat *et al.*, 2018).

In order to find out the effect of arecanut chewing on human health, perceptions about health benefits and risks, a house to house survey was conducted in certain major arecanut chewing areas of Kasaragod District in Kerala and Dakshina Kannada, Shivamogga and Uttara Kannada Districts in Karnataka, India during May-June, 2018 and the data are presented in this report. Only the traditional chewers who chewed betel quid without or with tobacco and the non-chewers were included in this observation.

Methods

A population survey was conducted, especially in villages, with the help of local people who were familiar with the area and families of that locality. The houses were selected at random and the family members were interviewed and data collected on the following aspects:

1. Number of persons in the family (above 15 years), their age and gender.
2. Number of people in the family chewing arecanut alone or betel quid (arecanut, betel leaf and calcium hydroxide) with or without tobacco.
3. Number of times chewing per day.
4. Whether they spit out the liquid or swallow
5. Since how many years they were chewing
6. The reasons for developing this chewing habit
7. Whether they had developed any major health problems after starting chewing
8. Whether they noticed any perceived benefits from chewing

Persons who chewed the packaged chewing products such as pan masala, gutkha, khaine, etc., where the actual contents and the quality of such products were not known were not included in the study. Those people who indulged in smoking tobacco and drinking alcohol were also excluded. Infrequent or occasional (not daily) chewers were recorded as non-chewers. The non-chewers were considered as control and the data were compared with those of chewers.

Results

Chewing data: Data were collected from 917 people from 412 families and classified into four age groups (15-39 years, 40-59 years, 60-79 years and 80 and more years) and three chewing types (Non Chewers, Betel Quid without tobacco (BQ) chewers and Betel Quid with tobacco (BQT) chewers). Among the 917 respondents, 232 (25%) were non chewers. People chewing

arecanut alone were very rare with only four (0.44%) persons indulged in that habit. Hence such people were included in the group of betel quid chewers without tobacco. Hence, there were 292 (32%) BQ chewers and 393 (43%) BQT chewers (Fig 1). All the chewing people used to chew for 10 to 30 minutes and spit out the remaining quid.

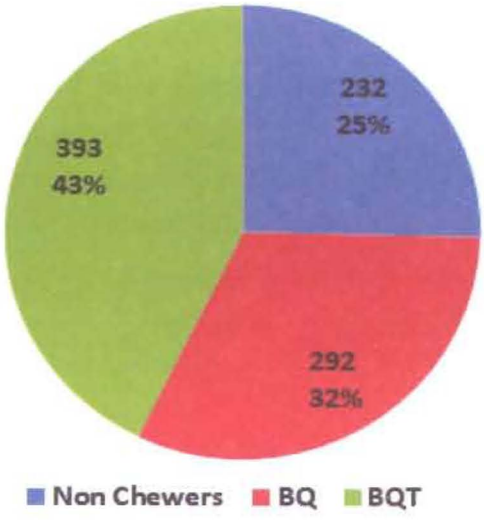

Fig. 1. Number/Percentage of people with different types of chewing (N=917)

Age criteria: Among the 917 respondents, 163 (18%) were in the age group of 15-39, 399 (43%) were in the age group of 40-59, 287 (31%) were in the age group of 60-79 and the remaining 68 (7%) were 80 or more years of age (Fig 2). When we observe for different chewing types and the age of people it is seen that in non- chewers, the percentage of people in the age group of 60 and above category was only 31%, whereas it was 43% and 41% in BQ and BQT chewing people, respectively (Fig 3). Further, it is seen that super seniors (80 years and above) were also found more in BQ (10%) and BQT (9%) chewers when compared to that of non chewers (3%). Interesting observation was that in non-chewers the maximum age noticed was 85 years, whereas it was 103 years in BQ and 102 years in BQT chewers.

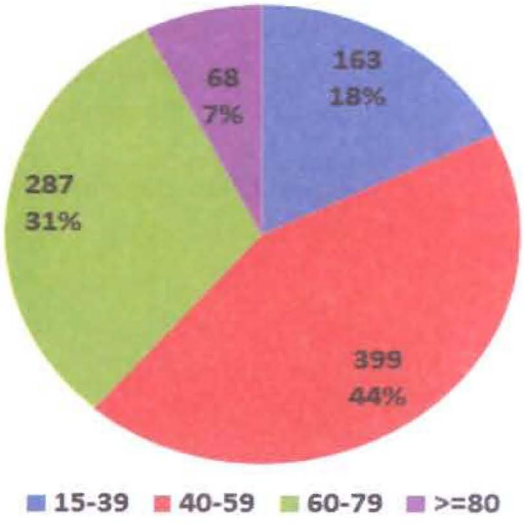

Fig 2. Total number/Percentage of people in different age groups (N=917)

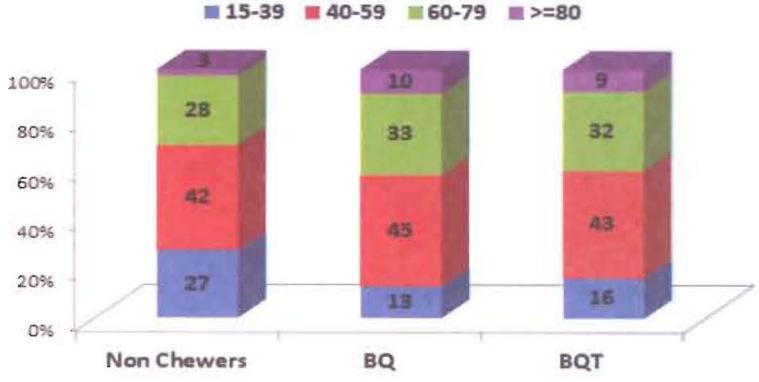

Fig 3. Percentage distribution of chewing types in different age groups

Frequency of chewing: Among the 232 respondents from the BQ chewers, 171 (58.56%) were chewing less than 5 times per day and only 4 (1.37%) were chewing 25 or more times in a day, whereas among the 392 respondents from the BQT chewers only 51 (12.98%) were chewing less than 5 times per day and 55 (14%) were chewing 25 or more times in a day. Nearly 84% of BQ chewers chewed less than 10 times / day, whereas in BQT chewers, as many as 55% of them chewed more than 10 times / day (Fig 4 & 5). This shows that BQ chewers are not as much addictive as that of BQT.

Period of chewing: Chewing for very long period of more than 50 years without any visible health problems was noticed in both BQ and BQT chewers. Twenty four (8%) people in BQ chewing group and 54 (14%) persons in BQT chewing group were having these habits for 50 years and even more (Fig 6 & 7). Only 15% of BQ and 10% BQT chewers chewed less than 10 years.

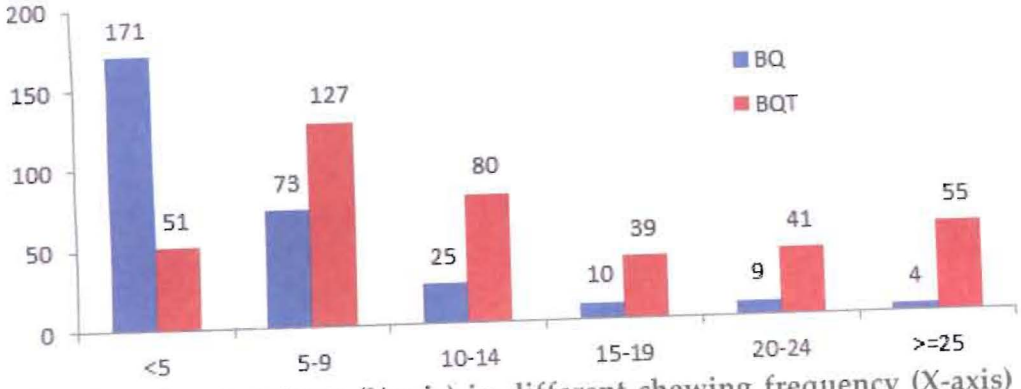

Fig4: Number of respondents (Y-axis) in different chewing frequency (X-axis)

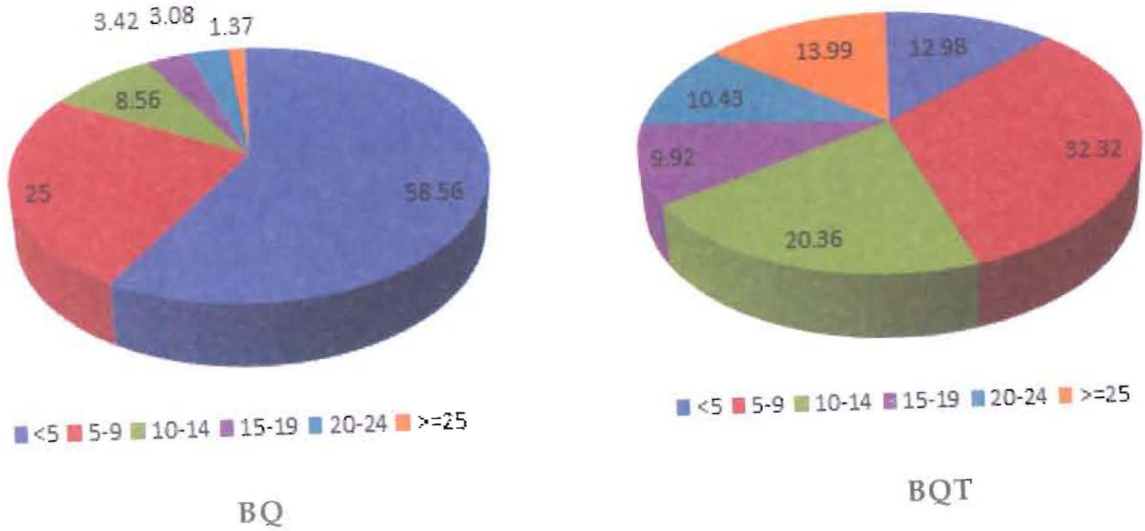

Fig.5: Percentage of respondents under different level of chewing frequency

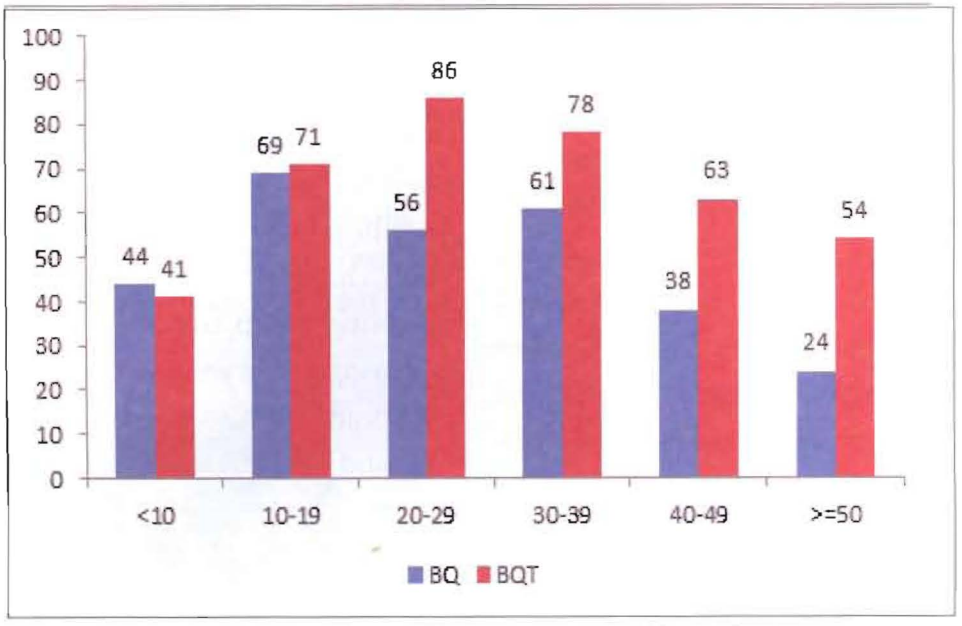

Fig 6: Period of chewing (X-axis) under two types of chewing BQ and BQT

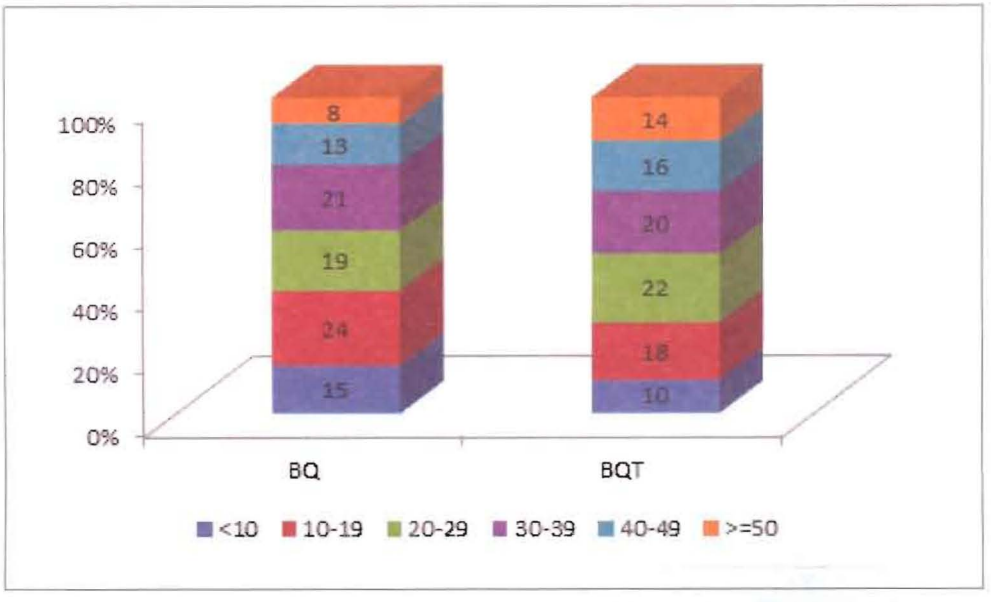

Fig 7: Percentage of respondents under different period of chewing

Perception of chewers on health issues: Of the total 685 chewing people surveyed, 256 gave their opinion on the health issues of chewing arecanut, BQ or BQT. None gave any adverse remark on such chewing habits on their health, but gave several beneficial effects on their health. Most of the people said that BQ chewing helped in digestion and reduced tooth pain. BQT chewing helped in keeping them active, reduced tooth pain and helped in digestion (Table 1).

Table 1: Perception of chewers on health issues of chewing

Perception	Chewing habits			
	BQ (N=292)		BQT (N=393)	
	No.	%	No.	%
Reduces tooth problems	28	9.59	48	12.21
Helps in digestion	58	19.86	24	6.11
Helps to remain active	14	4.79	64	16.28
Good for general health	4	1.37	8	2.04
As mouth freshener	3	1.03	2	0.51
Good for diabetes	1	0.34	1	0.25
Reduces hunger	Nil	--	1	0.25

Health status of chewing and non-chewing people: Of the 232 people surveyed in non chewing group 72 (31.03%) people reported certain health problems, whereas, in BQ chewing group, out of 292 people only 40 (13.70%) and in BQT chewing group out of 393 people 71 (18.07%) reported such problems (Table 2). There is no significant difference between non-chewers and chewers with regard to various health issues except for tooth problem. It is interesting to note that the tooth problem was significantly more in non chewers when compared to BQ and BQT chewers.

Table 2: Number of people with various health problems in non-chewers and chewers

Health Problems	Chewing habits					
	Non chewers (control) (N=232)		BQ only (N=292)		BQT (N=393)	
	No.	%	No.	%	No.	%
Cancer	2	0.86	Nil	--	1	0.25
BP	16	6.90	20	6.85	27	6.87
Diabetic	6	2.59	2	0.68	18	4.58
Tooth problem	42	18.10	6	2.05	15	3.82
Asthma/respiration	2	0.86	4	1.37	3	0.76
Heart problem	2	0.86	2	0.68	3	0.76
Any other	2	0.86	6	2.05	4	1.02
Total	**72**	**31.03**	**40**	**13.70**	**71**	**18.07**

Discussion

The present study clearly shows that chewing arecanut or betel quid without tobacco are beneficial and not harmful as far as their health effects on humans are concerned. Several other reports are also in conformity with this. In a study carried out by Shrihari *et al.* (2010) on a similar community in Dakshina Kannada District, it was reported that chewing arecanut or BQ had several beneficial effects. They did not notice any cancer or even pre-cancerous lesions in the oral cavity of such areca or BQ chewing people. In another study conducted on pan chewing people in Bangalore, India, Nandakumar *et al.* (1990) reported the relative risk of such habits for the occurrence of oral cancers as non-significant (p=0.36 for males and 0.17 for females). Chewing BQ without tobacco is also reported to be not harmful to pregnant women (Chue *et al.*, 2012). In a very large cohort study conducted by them on 7,685 BQ chewing women no adverse pregnancy effects were observed. They further reported that chewing BQ even reduced the bad effects of smoking on birth weight.

The contents of the betel quid are very important as far as its health effects are concerned. In countries such as Taiwan, Philippines, Papua New Guinea, etc., people mostly use the inflorescence of *P. betle* instead of its leaf (Wong *et al.*, 1992). The chemical constituents of each biological entity differ significantly. The inflorescence of *P. betle* contains good amount of safrol, a carcinogenic compound, whereas the leaf of that vine does not contain that chemical but contains hydroxichavicol, an anticancer drug (Wu *et al.*, 2004). This might be the reason why oral cancer is more prevalent in such countries where the people use the inflorescence of *P. betle*. In India the betel quid chewers use only the leaf of *P. betle* and not its inflorescence. The results of the present study are in conformity with this. There was no incidence of cancer in arecanut or BQ chewers but there were two cancer patients in non-chewers. Five BQ chewing people and 13 BQT chewing persons crossed 90 years and two BQ chewing people and one BQT chewing person crossed even 100 years by chewing 10 - 30 times per day for nearly 70 years. In non chewing group none was there in the very old age of 90 years and above.

Several animal studies also reported that arecanut and BQ are not carcinogenic. In a study conducted on hamsters by exposing their cheek pouches to the ingredients of BQ for several weeks no cancer was noticed (Dunham and Herrold, 1962). In a study conducted on rats by feeding individual components of BQ (20% arecanut powder, 20% betel leaf powder, 20% arecanut powder mixed with 1% lime) separately for 480 days, none of the animals fed with such diet mixed food showed any carcinogenic symptoms (Mori *et al.*, 1979). In another study carried out on both normal as well as immune suppressed mice for two years using the extracts of arecanut (from 100g arecanut) and BQ without tobacco (50g of arecanut + 100g of betel leaf + 4g of lime) no tumour growth was noticed, but there was a reduction in the incidence of tumours (Kumari *et al.*, 1974). The inhibitory action of arecoline hydrobromide, the major active principle of arecanut, on the growth and proliferation of cancer cells is reported by Fan *et al.* (2016). The results of the present study are also in

conformity with these observations. There was no incidence of cancer either in arecanut or in BQ chewing people. However, there was one (0.23%) incidence of cancer in BQT chewing group whereas there were two (0.87%) cases of cancers in non chewing group as well. The anti cancer principles present in arecanut and betel leaf might have reduced the cancerous effects of tobacco in BQT, thereby reducing the incidence of cancer in such chewers.

Tooth problem was significantly less in BQ and BQT chewing people when compared to non-chewers of arecanut. This is in conformity with the observations of Shrihari *et al.* (2010) who have reported that nearly 19% of BQ chewers perceived that chewing arecanut reduced tooth ache and prevented tooth decay. The antibacterial properties of arecanut on several oral microorganisms are well documented in the literature (Chin *et al.*, 2013). Several scientific observations revealed that chewing arecanut protected teeth against dental caries (Howden, 1984; Nigam and Srivastava, 1990). The procyanidines found in arecanuts were reported to be the antibacterial principles against the primary cariogenic bacteria, *Streptocaccus mutans* (Hada *et al.*, 1989). It was also reported that the anaerobic bacteria such as *Enterococcus faecalis*, which is responsible for endodontic infections in human teeth was susceptible for arecanut extract and the extract was found even better than that of Chlorhexidine, the chemical disinfectant presently used during root canal treatment (Arathi *et al.*, 2015).

Conclusion

The present study clearly indicates that the traditional chewing of arecanut (without any additives) or betel quid with or without tobacco is not harmful to humans. There was no significant difference between non-chewers and chewers in health issues except for tooth problem where, it is observed that the tooth problem was significantly more in non-chewers compared to the traditional chewers with or without tobacco.

References

Aman, 1969. *Medicinal secrets of your food. - Arecanut*, Published by: Secretary, Indo- American Hospital, N R Mohalla, Mysore-7, India. pp 700-702.

Ananda, K.S. 2004. Botany. In: *Arecanut.* (Eds: D. Balasimha and V. Rajagopal), Central Plantation Crops Research Institute, Kasaragod: 671 124, Kerala,India. pp 7-50.

Anthikat, R.R.N. and Michael, A. 2009. Study on the Arecanut for its antimicrobial properties. *J. Young Pharmacists*, 1:42-45.

Anthikat, R.R.N. and Michael, A. 2011. Anti-ulcerogenic effects of *Areca catechu* L. in Sprague dawley rats. *Int. J. Pharma. Sciences and Res.*, 2(1): 179-184.

Anthikat, R.R.N., Michael, A. and Ignacimuthu, S. 2012. Aphrodisiac effect of *Areca catechu* L. and *Pedalium murex* in rats. *J. Men's Health* (JMH), 10: 65-70.

Anthikat, R.R.N., Michael, A., Kinsalin, V.A. and Ignacimuthu, S. 2014. Antifungal activity of *Areca catechu* L. *Int. J. Pharma. Clinical Sci.*, 4: 1-3.

Anthikat, R.R., Michael, A., Vageesh, S., Balamurugan, R. and Ignacimuthu, S. 2014. The effect of *Areca catechu* L. extract on streptozotocin induced hyperglycemia in Wistar rats. *Int. J. Pharma. Bio. Sci.*, 5:

316-321.

Arathi, G., Venkateshbabu, N., Deepthi, M., Jayaleelashri, J., Saranya, V. and Kandaswamy D. 2015. *In-vitro* antimicrobial efficacy of aqueous extract of arecanut against *Entercoccus faecalis*. *Indian J. Res. Pharm. Biotech,* 3: 147-150.

Azeez, S., Amudhan, S., Adiga, S., Rao, N. and Udupa, L.A. 2007. Wound healing profile of Areca catechu extracts on different wound models in Wistar rats. *Kuwait Med. J.* 39(1): 48-52.

Bhandare, A., Kshirsagar, A., Vyawahare, N., Hadambar, A. and Thorve, S. 2010. Potential analgesic, anti-inflammatory and antioxidant activities of hydroalcoholic extract of *Areca catechu* L. nut. *Food Chem. Toxicol.*, 12: 3412-3417.

Bhandare, A., Kshirsagar, A., Vyawahare, N., Sharma, P. and Mohite, R. 2011. Evaluation of anti-migraine potential of *Areca catechu* to prevent nitroglycerin-induced delayed inflammation in rat meninges: possible involvement of NOS inhibition. *J. Ethnopharmacol.* 136: 267-70.

Bhat, P.S.I. and Rao, K.S.N. 1962. On the antiquity of arecanut. *Arecanut J.* 13 (1): 13-21.

Cherian, H. and Manojkumar, K. 2014. Arecanut Production Scenario in India, *Indian J. Arecanut Spices & Med. Plants,* 16(4): 3-11.

Chin, A.A., Fernandez, C.D., Sanchez, R.B., Santos, B.M.S., Tolentino R.F. and Masangkay F.R. 2013. Antimicrobial performance of ethanolic extract of *Areca catechu* L seeds against mixed- oral flora from tooth scum and gram negative laboratory isolates. *Int. J. Res. Ayurveda Pharm.* 4: 876-880.

Chue, A.L., Carrara, V.I., Paw, M.K., Pimanpanarak, M., Wiladphaingern, J., Vaugt, M., Lee. S.J., Nosten, F. and McGready, R. 2012. Is areca innocent? The effect of areca (betel) nut chewing in a population of pregnant women on the Thai-Myanmar border. *Int. Health,* 4: 204-209.

Dunham L.J. and Herrold, K.M. 1962. Failure to produce tumors in the hamster cheek pouch by exposure to ingredients of betel quid: histopathologic changes in the pouch and other organs by exposure to unknown carcinogens. *J. National Cancer Inst.* 29: 1047-1067.

Fan, J., Lin, R., Xia, S., Chen, D., Elf, S.E., Liu, S., Pan, Y., Xu, H., Qian, Z., Wang, M., Shan, C., Lu, Z., Lei, Q.Y., Li, Y., Mao, H., Lee, B.H., Jessica S., Ralph J.D., Zhang, D., Taofeek O., Gaddh, M., Arellano, M.L., Khoury, H.J., Khuri, F.R., Kang, S.,. Doetsch, P.W., Lonial, S., Boggon, T.J., Curran, W.J and Chen, J. 2016. Tetrameric Acetyl-CoA Acetyltransferase 1 is important for Tumor Growth. *Molecular Cell,* 64: 859-874.

Gupta, S.K. and Gupta, A. 2013. Alkaloids of processed green arecanut as an antidote of venom. *Medical Sci.,* 3(11): 381-382.

Hada, L.S., Kakiuchi, N., Hattori, M. and Namba, T. 1989. Identification of antibacterial principles against *Streptococcus mutans* inhibitory principles against glucosyltransferase from the seed of *Areca catechu* L. *Phytotherapy Res,* 3:

140-144.

Hazarika, D.J. and Sood, K. 2015. In vitro antibacterial activity of peptides isolated from *Areca catechu* L. *Der Pharmacia Lettre*, 7: 1-7.

Howden G.F. 1984. The cariostatic effect of betel nut chewing. *P N G Med J*, 27: 123-131

IARC, 2004. *Monographs on the evaluation of carcinogenic risks to humans. Betel quid and arecanut chewing and some arecanut derived nitrosamines* 85 IARC, Lyon, France. 349p.

Inokuchi, J., Okabe, H., Yamauchi, T., Nagamatsu, A., Nonaka, G. and Nishioka, I. 1986. Antihypertensive substance in seeds of *Areca catechu* L. *Life Sci.*, 38(15): 1375-1382.

Jiang, J.H., Jung, S.Y., Kim, Y.C., Shin, S.R., Yu, S.T. and Park, H. 2009. Antimalarial effects of *Areca catechu* L. Korean *J. Oriental Physiol. Pathol.* 23: 494-498.

Joshi, M., Gaonkar, K., Mangoankar, S. and Satarkar, S. 2012. Pharmacological investigation of *Areca catechu* extract for evaluation of learning, memory and behavior in rats. *Int. Current Pharmaceut. J.* 1(6); 128-132.

KeshavaBhat, S., Ashwin, D., Mythri, S. and SukeshBhat. 2018. Betel nut chewing and human health: certain glaring lacunae in research. *IOSR J. Dent. & Med. Sciences*, 17(5): 9-15.

Khan, S., Abbas, G., Ahmed, F.S., Rahman, A. and Dar, A. 2014. Effect of dichloromethane fraction of *Areca catechu* nut on monoamines associated behaviours and tyraminepressor sensitivity in rodents. *Pak. J. Pharmaceut Sci.* 27(2): 303-307.

Kirtikar, K.R., Basu, B.D. and An, I.C.S. 1918. *Indian Medicinal plants*, Vol IV (Reprint 1975), M/S Bishen Singh Mahendra Pal Singh, New Connaught Place, Dehra Dun, India. pp 2547-2549.

Kumari, L.H., Sirsi, M. and Bhargava, M.K. 1974. Inhibitory activity of *Areca catechu* on the development of mouse skin tumors induced by the chemical carcinogen 3:4, benzpyrene. *J. Plantn. Crops*, 2(1): 23-29.

Kusumoto, I.T., Nakabayashi, T., Kida, H., Miyashiro, M., Hattori, M. and Namba, T. 1995. Screening of various plant extracts used in ayurvedic medicine for inhibitory effects on human immunodeficiency virus type 1 (HIV-1) protease. *Phytotherapy Res.* 9: 180-184.

Lee, J. H., Chang, S. H., Park, Y.S., Hes, E, Lee, H.Y. and Park, J.W. 2004. *In-vitro* and *in-vivo* anti allergic actions of Areca semen. *J. Pharm. Pharmacol.* 56(7): 927.

Lee, K.K. and Choi, J.D. 1999. The effects of *Areca catechu* L extract on anti-aging. *Int. J. Cosmet. Sci.* 21(4): 285-295.

Nigam, P and Srivastava A.B. 1990. Betel chewing and dental decay. *Fed. Oper. Dent.* 1: 36-38.

Mori, H., Matsubara, N., Ushimaru, Y and Hirono, I. 1979. Carcinogenicity examination of betel nuts and *Piper betle* leaves. *Experientia*, 35(3): 384-385.

Nandakumar, A., Thimmasetty, K.T., Sreeramareddy, N.M., Venugopal, T.C., Rajanna, Vinutha, Srinivas, A.T. and Bhargava, M.K. 1990. A population-based case-control investigation on cancers of the oral cavity in Bangalore, India. *Br. J. Cancer*, 62: 847-851.

Oxenham, M.F., Locher, C., Cuong, N.L. and Thuy, N.K. 2002. Identification of *Areca catechu* (Betel nut) residues on the dentition of Bronze age inhabitants of Nui Np, Northern Vietnam. *J. Archeol. Sci.* 29: 1-7.

Park, Y.B., Jeon, S.M., Byun, S.J., Kim, H.S. and Choi, M.S. 2002. Absorption of intestinal free cholesterol is lowered by supplementation of *Areca catechu* L. extract in rats. *Life Sci.*, 70(16): 1849-1859.

Peng, W., Lie, Y.J., Wu, N., Sun, T., He, X.Y., Gao, Y.X. and Wu, C.J. 2015. *Areca catechu* (Arecaceae): A review of its traditional uses, botany, phytochemistry, pharmacology and toxicology. *J. Ethnopharma.* 164: 340-356.

Pithayanukul, P., Nithitanakool, S. and Bavovada, R. 2009. Hepatoprotective potential of extracts from seeds of *Areca catechu* and nutgalls of *Quercus infectoria. Molecules,* 14: 4987-5000.

Rao, M.M. 1982. Introduction. In: *The Arecanut Palm.* (Eds: K.V.A. Bavappa, M.K. Nair and T.P. Kumar). Central Plantation Crops Research Institute, Kasaragod, Kerala, India. pp 1-9.

Rahmatullah, M., Mukti, I.J., Haque, A.K.M.F., Mollik, M.A.H., Parvin, K., Jahan, R., Chowdhury, M.H. and Rahman, T. 2009. An ethnobotanical survey and pharmacological evaluation of medicinal plants used by the Garo tribal community living in Netrakona district, Bangladesh. *Adv. Natural & Applied Sciences*, 3: 402-418.

Rashid, M., Shamsi, S., Zaman, R. and Ilahi, A. 2015. *Areca catechu*: enfolding of historical and therapeutic traditional knowledge with modern update. *Int. J. Pharmacognosy*, 2: 221-228.

Sazwi, N.N., Nalina, T. and Rahim, Z.H.A. 2013. Antioxidant and cytoprotective activities of *Piper betle, Areca catechu, Uncarria gambir* and betel quid with and without calcium hydroxide. *BMC Complementary and Alternative Medicine*, 13: 351.

Senthil Amudan, M. and Haeena Begum, V. 2008. Protective effect of areca catechu extract on ethanol induced gastric mucosal lesions in rats, Pharmacologyonline, 1: 97-106

Shrihari, J.S.B., Melissa, D.B., Robert, L.B., Mimi, N. and Mark, N. 2010. Arecanut dependence among chewers in a South Indian community who do not also use tobacco. *Addiction*, 105: 1303-1310.

Sullivan, R.J., Allen, J.S., Otto, C., Tiobech, J. and Nero, K. 2000. Effects of chewing betel nut (*Areca catechu*) on the symptoms of people with schizophrenia in Palau, Micronesia. *Br. J. Psychiatry*, 177: 174 - 178.

Tavera, P.D.T.H. 1901. *The Medicinal Plants of the Philippines.* P. Blakiston's Son & Co., 1012, Walnut Street, Philadelphia, pp234-236.

Vermani, K.and Garg, S. 2002. Herbal medicines for sexually transmitted diseases and AIDS. *J. Ethno Pharmacol.* 80: 49-66.

Valenciano, L.A. and Cotiwan, B.S. 1980. The anthelmintic activity of betel nut (*Areca catechu*) against *Toxocara canis, M S A C Res. J. Mt. State Agric. Coll.* (6/7): 30-38.

WHO, 2009. Areca catechu L. In: *Medicinal Plants of Papua New Guinea*, World Health

Organization, Geneva, Switzerland, pp30-31.

Wong, T.Y., Jin, Y.T., Chen, H.O. and Lin, L.M. 1992. Studies on Taiwan betel quid carcinogenicity in Hamster cheek pouch. *Chin. Dent. J.* 11(4): 155-162.

Wu, M.T., Wu, D.C., Hsu, H.K., Kao, E.L. and Lee, J.M. 2004. Constituents of areca chewing related to esophageal cancer risk in Taiwanese men. *Dis Esophagus,* 17(3): 257-259.

***

The Directorate had participated in the VIAGA-2020 held at Thekkinkad Maithanam, Thrissur, Kerala during 4-8 January, 2020 organized by the Department of Agriculture Development and Farmers Welfare, Government of Kerala

Shri K.Krishnankutty, Hon'ble Minister for Water Resources of Kerala state visiting the stall.