BETEL-QUID AND ARECA-NUT CHEWING

1. Exposure Data

1.1 Composition of betel quid

Areca-nut/betel-leaf/tobacco chewing habits are widely prevalent in many parts of Asia and in migrant communities arising therefrom. Many betel-quid products in different parts of the world are not actually chewed; rather, they are placed in the mouth or applied to the oral cavity and remain in contact with the oral mucosa. Nevertheless, it is recommended that they all be considered as part of the betel-quid chewing habit. Given the varied ingredients and combinations used in different parts of the world, an accurate description of terms is essential (see Glossary A for definitions and synonyms).

1.1.1 *Betel quid*

The term 'betel quid' is often used with insufficient attention given to its varied contents and practices in different parts of the world. A 'betel quid' (synonymous with '*pan*' or '*paan*') generally contains betel leaf, areca nut and slaked lime, and may contain tobacco. Other substances, particularly spices, including cardamom, saffron, cloves, aniseed, turmeric, mustard or sweeteners, are added according to local preferences. In addition, some of the main ingredients (tobacco, areca nut) can be used by themselves or in various combinations without the use of betel leaf. Numerous commercially produced mixtures containing some or all of these ingredients are also available in various parts of the world. A consensus workshop held in 1996 (Zain *et al*., 1999) recommended that the term 'quid' should be defined as 'a substance, or mixture of substances, placed in the mouth […], usually containing at least one of the two basic ingredients, tobacco or areca nut, in raw or any manufactured or processed form.'

A chewing substance may primarily consist of (Table 1):

- areca nut alone, without any betel leaf, slaked lime or tobacco
- chewing tobacco without any areca nut
- areca nut with components of betel vine and any other ingredients except tobacco (betel quid without tobacco)
- areca nut with components of betel vine and any other ingredients including tobacco (betel quid with tobacco).

Table 1. Composition of the different types of chewing substances

	Areca nut[a]	Betel[b]			Catechu[d]	Tobacco[e]	Slaked lime
		Leaf	Inflo-rescence	Stem[c]			
Areca	X						
Betel quid without tobacco	X	X			(X)[f]		X
Betel quid with tobacco	X	X			(X)[f]	X	X
Gutka	X				X	X	X
Pan masala[g]	X				X		X
Khaini						X	X
Mawa	X					X	X
Mainpuri tobacco	X					X	X
Lao-hwa (Taiwan)	X[g]		X				X
Betel quid (Taiwan)	X[g]	X					X
Stem quid (Taiwan)	X[g]			X			X
Naswar						X	X
Zarda						X	X

[a] May be used unripe, raw or processed by baking, roasting or baking with sweetening, flavouring and decorative agents (see Table 2).
[b] In place of the leaf, the inflorescence or its stem may also be used (see Table 2).
[c] Stem of inflorescence
[d] In powdered or paste form (see Table 2)
[e] In flaked, powdered or paste form, with or without processing, with or without sweetening (see Table 2)
[f] ( ) means optional
[g] Used in unripe form

It is recommended that, when the term 'betel quid' is used, other ingredients used to make up the quid be specified. A betel quid is often formulated to an individual's wishes with selected ingredients. In many countries, ready-made, mass-produced packets of the above products are now available as proprietary mixtures known as *pan masala* or *gutka* (see Section 1.2). The major constituents of a betel quid are listed in Table 2 and are outlined below.

1.1.2 *Areca nut*

Areca nut is the seed of the fruit of the oriental palm *Areca catechu*. It is the basic ingredient of a variety of widely used chewed products. Use of the term 'betel nut' is not botanically correct; it has caused considerable confusion in the scientific literature and should be avoided.

Areca nut is an important agricultural product in many regions of the world. The world's largest producers of areca nut, as estimated by the Food and Agriculture Organiza-

Table 2. Constituents of betel quid

Constituent	Origin/preparation
Areca nut	Unripe/ripe Whole/sliced Raw/roasted/sun dried Boiled/soaked in water Fermented (under mud)
Piper betle L.	Fresh leaf Inflorescence Stem
Slaked lime	From coral From shell fish From quarried lime stone
Tobacco	Sun dried Fermented Boiled with molasses Perfumed Concentrated extract (kiwam)
Catechu (extracted from)	• Heartwood of *Acacia catechu* or *A. suma* • Leaves of *Uncaria gambier* • Bark of *Lithocarpus polystachya* (*nang ko*)
Spices	Cloves Cardamom Aniseed (± sugar coat)
Sweeteners	Coconut Dried dates
Essences	Rose essence Menthol Mint Rose petals

Updated from Gupta & Warnakulasuriya (2002)

tion (FAO), are listed in Table 3. The FAO has estimated that world production of areca nut is increasing (FAO, 2003). In most South Asian countries where information is available, the production of areca nut has increased several fold over the past four decades. In India, production of the nut has risen nearly threefold and may reflect the commercialization of areca products since the early 1980s. Notably, Bangladesh is a significant contributor to the agricultural base of areca-nut production, but its use by the Bangladeshi population is not well documented (see Section 1.3.3).

There are several palms under the genus *Areca* that are native to South and South-East Asia and the Pacific islands. An annotated list of the *Areca* species according to their geo-

Table 3. Production of areca nut by country since 1961 (in millions of tonnes)

Country	1961	1971	1981	1991	2001
Bangladesh	62 995	23 369	25 051	24 120	47 000
India	120 000	141 000	195 900	238 500	330 000
Indonesia	13 000	15 000	18 000	22 812	36 200
Kenya	NA	NA	NA	100	90
Malaysia	6 500	3000	2 500	4000	2500
Maldives	1	1	5	16	37
Myanmar	8000	19 203	25 807	32 270	51 463
Taiwan, China[a]	3718	10 075	24 358	111 090	165 076
Thailand	NA	NA	NA	13 250	20 500
World	428 428	423 296	583 242	892 316	1 305 732

From FAO (2003)
NA, not available
[a] From Council of Agriculture, ROC (2003)

graphical cultivation in South and South-East Asia and in the Pacific basin was given by Furatado (1933). Areca nut for chewing is obtained exclusively from *Areca catechu*, which is believed to be native to Sri Lanka, West Malaysia and Melanesia (IARC, 1985a). This tropical palm tree bears fruit all year, which are ovoid or oblong with a pointed apex, measuring 3–5 cm in length and 2–4 cm in diameter. The outer surface is green when unripe and orange-yellow when ripe. The seed (endosperm) is separated from a fibrous pericarp, is rounded with a truncated base and is opaque and buff-coloured with dark wavy lines. It has a characteristic astringent and slightly bitter taste and is consumed at different stages of maturity according to preference. An individual may consume the whole nut or thin slices of the nut, in its natural state or after processing in many forms.

The nut may be used fresh or it may be dried and cured before use, by sun-drying, baking or roasting (Table 2). Areca fruit may also be boiled and fermented (in eastern parts of India, Sri Lanka) by covering it with mud to soften the nut for consumption. These treatments change the flavour of the nut and its astringency. In Taiwan, China, areca nut is most often used in the unripe stage when it is green, like a small olive.

Areca nut is known colloquially in Hindi and other languages in India as *supari*; it is called *puwak* in Sri Lanka, *gua* in Sylheti (Bangladesh), *mak* in Thailand, *pinang* in Malaysia, *daka* in Papua New Guinea, *pugua* in Guam and *Kun-ywet* in Myanmar (IARC, 1985a).

Chemical constituents

Comprehensive analyses of the chemical composition of areca nut have been reported and reviewed (Raghavan & Baruah, 1958; Shivashankar *et al.*, 1969; Arjungi, 1976; Jayalakshmi & Mathew, 1982). The major constituents of the nut are carbohydrates, fats,

proteins, crude fibre, polyphenols (flavonols and tannins), alkaloids and mineral matter. The ranges in concentration of the chemical constituents of areca nut are given in Tables 4 and 5. Variations in the concentrations of the various constituents may occur in nuts from different geographical locations and according to the degree of maturity of the nut. Of the chemical ingredients, tannins, alkaloids and some minerals that may have biological activity and adverse effects on tissues have been subjected to detailed study.

Polyphenols (flavonols, tannins) constitute a large proportion of the dry weight of the nut. The ranges in concentration of polyphenols in unprocessed and processed nuts are shown in Tables 4 and 5. The polyphenol content of a nut may vary depending on the region where *Areca catechu* is grown, its degree of maturity and its processing method. The tannin content is highest in unripe areca nuts and decreases substantially with increasing maturity (Raghavan & Baruah, 1958). The roasted nut possesses the highest average content of tannins, ranging from 5 to 41% (mean, 21.4%); the average tannin content of sun-dried nuts is 25%; and the lowest levels are seen in boiled nuts, which contain 17% (Awang, 1987).

Polyphenols are responsible for the astringent taste of the nut (Raghavan & Baruah, 1958).

Alkaloids: Among the chemical constituents, alkaloids are the most important biologically. The nut has been shown to contain at least six related alkaloids, of which four (arecoline, arecaidine, guvacine and guvacoline) (Figure 1) have been conclusively identified in biochemical studies (Raghavan & Baruah, 1958; Huang & McLeish, 1989; Lord *et al*., 2002). Arecoline is generally the main alkaloid. The ranges in concentration of arecoline in unprocessed and processed nuts are given in Tables 4 and 5.

The contents in the four major alkaloids of fresh areca nuts obtained from Darwin, Australia, have been determined by high-performance liquid chromatography (Table 6).

Table 4. Ranges in concentration[a] of the chemical constituents of a variety of unprocessed green and ripe areca nuts

Constituents	Green (unripe) nut	Ripe nut
Moisture content	69.4–74.1	38.9–56.7
Total polysaccharides	17.3–23.0	17.8–25.7
Crude protein	6.7–9.4	6.2–7.5
Fat	8.1–12.0	9.5–15.1
Crude fibre	8.2–9.8	11.4–15.4
Polyphenols	17.2–29.8	11.1–17.8
Arecoline	0.11–0.14	0.12–0.24
Ash	1.2–2.5	1.1–1.5

From Jayalakshmi & Mathew (1982)

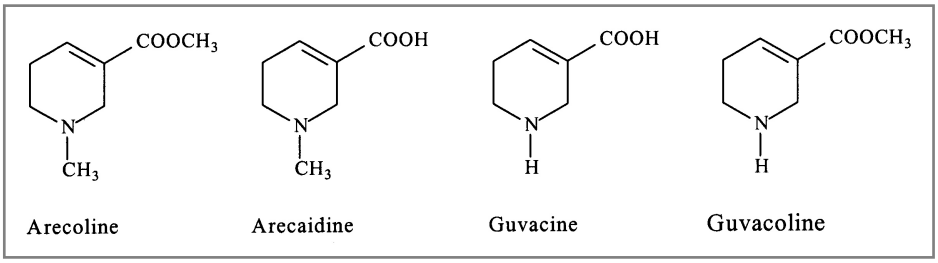
[a] Percentage based on dry weight (except moisture)

Table 5. Ranges in concentration[a] of some chemical constituents of a variety of processed areca nuts in India

Type/trade name	No. of samples analysed	Poly-phenols (%)	Arecoline (%)	Fat (%)	Crude fibre (%)	Total poly-saccharides (%)
Chali	65	7.3–34.9	0.1–0.7	4.9–24.4	7.1–17.4	14.3–26.3
Parcha	18	11.7–25.0	0.1–0.5	12.3–18.1	8.0–14.3	13.0–27.3
Lyon	25	19.6–45.9	0.1–0.7	6.8–18.1	5.4–13.3	13.5–28.2
Api	54	15.2–41.3	0.2–0.9	5.3–18.5	5.4–18.5	9.2–28.2
Batlu	31	22.4–55.2	0.1–0.9	4.3–17.9	3.1–12.3	14.2–27.0
Choor	33	24.9–43.7	0.1–0.9	5.9–17.8	5.1–15.2	11.1–28.1
Erazel	9	16.9–38.0	0.2–0.8	5.5–12.3	5.9–8.7	13.1–26.6
Chalakudi	3	32.0–39.3	0.4–0.9	7.1–10.5	5.3–14.9	22.1–26.9
Nuli	6	39.0–47.9	0.6–0.9	3.7–13.8	3.8–6.0	16.4–22.7

From Shivashankar *et al*. (1969)
[a] Percentages based on dry weight

Figure 1. Chemical structure of areca alkaloids



From Mujumdar *et al.* (1982)

Table 6. Alkaloid content of fresh areca nuts from Darwin, Australia

Alkaloid	% Nut[a]
Arecoline	0.30–0.63
Arecaidine	0.31–0.66
Guvacoline	0.03–0.06
Guvacine	0.19–0.72

From Huang & McLeish (1989)
[a] [Percentage not specified, probably based on dry weight]

The levels were slightly higher than those observed for Indian and Papua New Guinean nuts. The authors concluded that this difference may result from seasonal and geographical variations (Huang & McLeish, 1989).

In an aqueous extract of Taiwanese betel quid composed of fresh areca nut, betel inflorescence and red lime paste (80.5:12.5:7 by weight), arecaidine was the most abundant alkaloid (7.53 mg/g dry wt) and guvacoline the least abundant (0.26 mg/g dry wt). No change in the levels of alkaloids was observed during cold storage or during the process of freeze-drying (Wang *et al*., 1999).

Examining volatile alkaloids in areca nut [source unspecified] by gas chromatography–mass spectrometry, Holdsworth *et al*. (1998) and Self *et al*. (1999) described the presence of at least six other related alkaloids in addition to arecoline and guvacoline. These were identified as nicotine (~0.02%), methyl nicotinate, ethyl nicotinate, methyl- and ethyl-*N*-methyl piperidine-3-carboxylate and ethyl-*N*-methyl-1,2,5,6-tetrahydro-pyridine-3-carboxylate.

Wide variations in the arecoline content of areca nut have been demonstrated in commercially available nuts, ranging between 0 and 1.4% (Table 5; Awang, 1986; Canniff *et al*., 1986). Arecoline content is reduced following processing of the nut (Awang, 1988). The content is reduced from 1.4% to 1.35% by sun-drying, to 1.29% by roasting, to 0.7% by soaking in water and to 0.1% by boiling in water (Awang, 1988). The practice of boiling the nut in a liquor obtained from the previous year's boiling is designed to increase the alkaloid content of treated nuts (Canniff *et al*., 1986).

Elemental composition: Concentrations of sodium, magnesium, chlorine calcium, vanadium, manganese, copper and bromine were measured in areca nut, *pan masala* and other chewing materials available in the United Kingdom (Ridge *et al*., 2001). The values obtained for areca nut were lower than those reported in areca nut from Taiwan, China (Wei & Chung, 1997), but generally showed good consistency. Mean concentrations of 36 elements in areca nut, betel leaf, slaked lime and catechu are shown in Table 7 and Figure 2 (Zaidi *et al*., 2002).

In view of possible fibrogenic, mutagenic and toxic effects of areca nut, the copper content in samples of raw and processed areca nut was analysed and reported to be much higher than that found most frequently in other nuts consumed by humans (Trivedy *et al*., 1997). The mean concentration of copper in samples of processed, commercially available areca nut was 18 ± 8.7 μg/g (Trivedy *et al*., 1999). In an Indian Food Report, the copper content of processed areca nut was found to be 2.5 times that of the raw nut (Gopalan *et al.*, 1989).

Areca-nut-derived nitrosamines: No study has been undertaken to determine areca-nut-derived nitrosamines in any variety of areca nut (J. Nair, personal communication).

Table 7. Concentration[a] of trace elements in betel-quid ingredients

Element[b]	Areca nut	Betel leaf	Slaked lime	Catechu
Cr (µg/g)	0.50 ± 0.06	0.46 ± 0.06	19.2 ± 2.9	7.3 ± 1.2
Mn (µg/g)	47 ± 6	380 ± 38	57.1 ± 8.6	170 ± 20
Fe (µg/g)	75 ± 8	171 ± 21	190 ± 29	5156 ± 774
Co	27 ± 4	132 ± 16	66 ± 9	2250 ± 360
Zn (µg/g)	5 ± 1	16.6 ± 2.2	1.24 ± 0.19	1.77 ± 0.27
Mg (µg/g)	2.8 ± 0.4	6.2 ± 0.9	1.30 ± 0.06	19.4 ± 2.9
Na (µg/g)	127 ± 14	793 ± 95	67 ± 7	6424 ± 964
K (% wt)	0.43 ± 0.04	4.42 ± 0.44	0.013 ± 0.002	0.46 ± 0.07
Ba (µg/g)	1.7 ± 0.3	15.4 ± 1.8	16.0 ± 2.4	7.7 ± 1.2
Ca (µg/g)	1.2 ± 0.2	4.8 ± 0.7	NA	12.6 ± 1.2
Ga	9 ± 1	16 ± 3	5 ± 1	58 ± 9
Al (µg/g)	2.9 ± 0.5	5.7 ± 0.8	7.2 ± 1.2	18.4 ± 0.2
V	12 ± 2	26 ± 4	15 ± 2	67 ± 10
Ti	14 ± 2	36 ± 6	48 ± 7	73 ± 12
In	18 ± 3	26 ± 4	31 ± 5	89 ± 13
Sn (µg/g)	1.4 ± 0.2	7.2 ± 1.1	9.4 ± 1.4	23.1 ± 3.4
Sb	13 ± 2	46 ± 5	404 ± 60	1100 ± 200
As (µg/g)	0.34 ± 0.04	18.3 ± 2.2	0.28 ± 0.04	5.96 ± 0.89
Se	120 ± 20	38 ± 5	70 ± 8	1045 ± 158
Hg	6 ± 1	9 ± 1	8 ± 1	12 ± 2
Cl (% wt)	0.15 ± 0.02	0.55 ± 0.1	ND	0.064 ± 0.01
Br (µg/g)	7.2 ± 0.9	7.1 ± 0.9	0.46 ± 0.07	0.61 ± 0.01
Cs	250 ± 40	7 ± 1	6 ± 1	14 100 ± 2100
Sc	18 ± 2	33 ± 4	274 ± 41	2490 ± 398
Rb (µg/g)	57 ± 7	225 ± 27	20.2 ± 2.8	232 ± 37
Ta	7 ± 1	9 ± 2	38 ± 6	1100 ± 180
La	44 ± 4	37 ± 4	2958 ± 473	7300 ± 1022
Ce (µg/g)	0.24 ± 0.04	1.14 ± 0.20	8.5 ± 1.3	20.6 ± 3.1
Nd	10 ± 2	18 ± 2	16 ± 2	21 ± 3
Sm	23 ± 4	35 ± 5	19 ± 3	51 ± 8
Eu	5 ± 1	7 ± 1	120 ± 20	296 ± 44
Gd	21 ± 5	12 ± 2	38 ± 6	49 ± 7
Tb	10 ± 2	9 ± 1	90 ± 10	121 ± 18
Dy	12 ± 2	10 ± 2	26 ± 3	38 ± 4
Yb	8 ± 1	78 ± 13	347 ± 56	2142 ± 343
Hf	18 ± 2	98 ± 12	78 ± 12	1200 ± 200

From Zaidi *et al*. (2002)
NA, not applicable; ND, not detected
[a] Mean ± standard deviation of five determinations
[b] Values expressed in ng/g dry weight, unless otherwise specified

Figure 2. Trace elements found in the main ingredients of betel quid

	Groups																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA			IB	IIB	IIIB	IVB	VB	VIB	VIIB	VIII
	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	1 72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	2 104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub		114 Uuq		116 Uuh		118 Uuo
6				1 58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
7				2 90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

1.1.3 *Betel leaf*

The most common accompaniment for chewing areca nut globally is the leaf of *Piper betle*. This has led to areca nut being labelled 'betel nut' in the English literature, but the Working Group does recommend this nomenclature.

Betel leaves contain betel oil, a volatile liquid, which contains several phenols including hydroxychavicol, eugenol, betel phenol and chavicol. Vitamin C (1.9 mg/g) and a large amount of carotenes (80.5 mg/g) have also been reported (Wang & Wu, 1996).

Mean concentrations of 36 trace elements in betel leaf are listed in Table 7 and Figure 2 (Zaidi *et al*., 2002).

1.1.4 *Betel inflorescence*

Apart from the leaf, other parts of the vine such as the stem, inflorescence (also called flower or pods) or catkins are also consumed with areca nut (Tables 1 and 2). Consumption of the inflorescence is common in Melanesia and in parts of Taiwan, China, and it is mostly added to the quid for its aromatic flavour.

Betel inflorescence contains a high concentration of phenolic compounds including hydroxychavicol, eugenol, isoeugenol, eugenol methyl ester and safrole (Hwang *et al*., 1992; Wang & Hwang, 1993). Concentrations of phenolic compounds in fresh *Piper betle* flower, determined by high-performance liquid chromatographic analysis, are listed in Table 8. Safrole, the major phenolic compound, is a possible human carcinogen (IARC, 1976).

Table 8. Concentrations of phenolic compounds in fresh *Piper betle* flower by high-performance liquid chromatographic analysis

Phenolic compound	Molecular weight (g)	Concentration (mg/g fresh wt)
Safrole	162	15.35
Hydroxychavicol	151	9.74
Eugenol	164	2.51
Eugenol methyl ester	178	1.81
Isoeugenol	164	1.81
Quercetin	338	1.11

From Hwang *et al*. (1992)

1.1.5 *Slaked lime*

Slaked lime (calcium hydroxide) is often combined with areca nut (Table 1). In coastal areas, it is obtained by heating the covering of shell fish (sea shells) or is harvested from corals. In central parts of a country, it is quarried from limestone (Table 2). In the

Asian markets, slaked lime is sold as a paste mixed with water, which is white or pink. In Papua New Guinea, slaked lime is available in the powdered form and stored in air-tight containers.

Free calcium hydroxide, iron(II) and magnesium(II) were measured in 25 samples of slaked lime from Papua New Guinea, and large variations in their concentrations were found (Nair *et al*., 1990). Mean concentrations of 35 trace elements measured in slaked lime are listed in Table 7 and Figure 2 (Zaidi *et al*., 2002).

1.1.6 *Catechu*

Catechu is an astringent, reddish-brown substance which is often smeared on the betel leaf used to wrap the ingredients of betel quid. Two main types of catechu may be used depending on the tree or shrub from which the catechu has been extracted (Table 2). One type of catechu is prepared by decoction and extraction from the heartwood of *Acacia catechu*, Willd. (N.O. Leguminosae), a tree indigenous to India and Myanmar. It is sometimes referred to as black catechu or cutch. The main constituents are catechu-tannic acid (25–35%), acacatechin (2–10%), quercetin and catechu red. Another type of catechu is an aqueous extract prepared from the leaves and young shoots of *Uncaria Gambier*, Roxb. (N.O. Rubiaceae), a climbing shrub indigenous to the Malay Archipelago. It is sometimes referred to as pale catechu or *gambir*. The main constituents are catechin (7–33%), catechu-tannic acid (22–50%), quercetin and catechu red (Council of the Pharmaceutical Society of Great Britain, 1911). In addition, in Northern Thailand, catechu may be derived from the sun-dried pounded bark of *Lithocarpus polystachya*. It is referred to as *nang ko* (Mougne *et al*., 1982).

Mean concentrations of 35 trace elements measured in catechu are listed in Table 7 and Figure 2 (Zaidi *et al*., 2002).

1.1.7 *Tobacco*

Tobacco is often added to the quid mixture. Chewing tobacco in the Indian subcontinent is prepared from sun-dried and partly fermented, coarsely cut leaves of *Nicotiana rustica* and *Nicotiana tabacum* without further processing. Sometimes tobacco is powdered and combined with molasses or boiled before use (Table 2).

1.1.8 *Miscellaneous additives and contaminants*

Some of the most common additives are listed in Table 2.

Sago palm nut is sometimes used as an adulterant in packages of sun-dried or processed areca nut. Sweet potato and tapioca are other adulterants (Jayalakshmi & Mathew, 1982).

Areca nut can be contaminated with fungi such as *Aspergillus flavus*, *A. niger* and *Rhizopus sp.* (Borle & Gupta, 1987). Almost 40% (12/32) of samples of areca nut from India analysed using thin-layer chromatography contained aflatoxins (IARC, 2002). The mean concentration of aflatoxin B_1 in the analysed samples was 94 µg/kg (range,

18–208 µg/kg), largely exceeding the commonly accepted food limit of 5 µg/kg. Nine samples contained concentrations of aflatoxin B_1 higher than 50 µg/kg (Raisuddin & Misra, 1991). All 10 samples of raw areca nut analysed in a South African study contained aflatoxin B_1, with a mean concentration of 5 µg/kg (range, 2.1–10.2 µg/kg) (Van der Bijl *et al*., 1996).

1.2 Areca nut-based industrial packaged products

A variety of packaged areca products are now available in several countries. Based on labelling, these packaged products may fall into any one of the four categories described in Section 1.1.1, depending on the substances included (see Table 1).

Two main products are *gutka* and *pan masala*. *Gutka* is a dry, relatively non-perishable commercial preparation containing areca nut, slaked lime, catechu, condiments and powdered tobacco. The same mixture without tobacco is called *pan masala*. The products arrived on the market in the late 1960s and early 1970s. Both *gutka* and *pan masala* come in attractive foil packets (sachets) and tins which can be stored and carried conveniently. Aggressive advertising, targeted at the middle class and adolescents since the early 1980s, has enhanced the sales of these products. In advertisements, *pan masala* is depicted as implying hospitality and equality, as is betel quid. *Pan masala* and *gutka* are very popular in urban areas of India and Pakistan, especially among adolescents, and their popularity is growing fast in rural areas (Gupta & Ray, 2002). Although the actual prevalence of this habit is unknown, its popularity can be gauged by current commercial estimates valuing the Indian market for *pan masala* and *gutka* at several hundred million US dollars. These products are exported to all countries where Asian migrants live (see Section 1.3.20).

1.3 Consumption by geographical region

Global estimates report up to 600 million chewers (Gupta & Warnakulasuriya, 2002). This section reviews patterns and prevalence of consumption in different countries. For the sake of clarity, the nomenclature has been made uniform throughout the section (see Glossary A for definitions).

1.3.1 *India*

Countrywide surveys on the use of areca nut have not been conducted, nor have any other surveys been conducted to investigate specifically the use of areca nut. Surveys of habits have been conducted on the use of tobacco and other chewing habits, especially betel-quid chewing, in limited populations. Studies of adults are presented first, followed by those of children and adolescents. Within these categories, rural studies are presented first, followed by available urban studies.

The tobacco included in betel quid varies from region to region. In Uttar Pradesh, *mainpuri* tobacco, which is a mixture of tobacco with slaked lime, finely cut areca nut and powdered cloves or camphor, is commonly used (Wahi, 1968).

(*a*) *Adults*

(i) *Rural studies*

Several studies have investigated the prevalence of betel-quid chewing in limited population samples.

The prevalence of all chewing habits, with and without areca nut and with and without tobacco, was recorded in house-to-house surveys among villagers in various parts of India (Mehta *et al.*, 1971, 1972). There were marked differences between localities and some differences between sexes (Table 9).

In Ernakulam District, Kerala, information on smoking and chewing habits was collected during a survey of oral lesions in a sample of 5099 persons aged 15 years and older (Daftary *et al*., 1980). Betel-quid chewing, mostly with tobacco, was practiced by 23.7%, smoking by 21.5% and both habits by 9.8% (Table 10). Overall, 34.7% of men and 32.4% of women indulged in the habit, and only about 0.7% chewed betel quid without consuming any form of tobacco.

In another house-to-house survey during 1977–78 in Ernakulam District, 12 212 tobacco users aged 15 years or older were identified in a rural population of about 48 000 (Gupta *et al.*, 1986, 1989). Of these, 11 412 were interviewed. Among tobacco users, 37.7% were chewers only, mostly of betel quid, and 14.3% both chewed and smoked (Table 11). Thus, approximately 50% of tobacco users chewed betel quid. Among tobacco users, 95.5% of women and 33.6% of men (of whom more than half also smoked) chewed. Betel-quid chewing was most common in the group aged 35 years and above.

Table 9. Prevalence of chewing habits (with and without smoking) in house-to-house surveys among villagers in India[a]

Location (state)	Sample size	Prevalence of chewing habits (%)	
		With tobacco	Without tobacco
Andhra Pradesh	10 169	2.3	0.5
Bihar, Darbhanga	10 340	15	1.3
Bihar, Singhbhum	10 048	13	0.4
Gujarat	10 071	3	1.5
Kerala	10 287	26	0.4
Maharashtra	101 761[b]	28	0.6

[a] From Mehta *et al*. (1971), unless otherwise specified
[b] From Mehta *et al*. (1972)

Table 10. Prevalence of tobacco and areca-nut habits in a population ≥ 15 years old in Ernakulam District, Kerala, India

Habit	Men		Women		All	
	No.	%	No.	%	No.	%
No habit	467	19.6	1828	67.2	2295	45.0
Smoking only	1087	45.6	11	0.4	1098	21.5
Chewing only	338	14.2	868	31.9	1206	23.7
With tobacco					1170	23.0
Without tobacco					36	0.7
Both habits	487	20.5	13	0.5	500	9.8
Total	2379	100.0	2720	100.0	5099	100.0

From Daftary *et al*. (1980)

Table 11. Prevalence of tobacco and areca-nut habits among tobacco users ≥ 15 years old in Ernakulam District, Kerala, India

Tobacco habit	Men		Women		All	
	No.	%	No.	%	No.	%
Smoking only	5330	66.5	150	4.4	5480	48.0
Chewing only[a]	1137	14.2	3162	93.2	4299	37.7
Both habits	1554	19.4	79	2.3	1633	14.3
Total	8021	100.0	3391	100.0	11 412	100.0

From Gupta *et al.* (1986)

[a] Tobacco was chewed mostly in the form of betel quid.

In 1986, a house-to-house survey of tobacco habits was conducted among 30 544 villagers of all ages in 373 villages in three areas of Kolar District, Karnataka, to gather baseline information for an intervention study (Anantha *et al*., 1995). About 8–16% of men and 29–39% of women had chewing habits (Table 12). While the content of the substances chewed was not defined in this study, a case–control study carried out in Karnataka by one of the authors identified the chewing habits of women as including tobacco, betel leaf, areca nut and slaked lime and as being the only tobacco habit of women (Carley *et al*., 1994).

Mawa is popular in Gujarat, India, especially among the young. The prevalence of this habit increased tremendously in the 1970s and 1980s (Sinor *et al*., 1990).

Table 12. Prevalence of tobacco and areca-nut habits among villagers in Kolar District, Karnataka, India

Habit	Dibbur	Malur	Gudiband
Men			
No.	5464	5369	4893
Tobacco smoking	17.7%	21.0%	21.7%
Tobacco chewing	16.4%	7.7%	8.4%
Women			
No.	5236	4905	4677
Tobacco smoking	0%	0%	0%
Tobacco chewing[a]	38.5%	28.7%	30.4%

From Anantha *et al*. (1995)
[a] Inferred as betel quid with tobacco from Carley *et al*. (1994)

The distribution of areca-nut use and tobacco smoking and chewing habits was assessed through a house-to-house survey in Bhavnagar District, Gujarat. Of 21 842 villagers aged 15 years and above (Gupta *et al*., 1998), 2298 men (20.4% of all men) were chewing only and used areca nut in the form of *mawa* or betel quid with tobacco (Table 13).

Table 13. Prevalence of tobacco and areca-nut habits among villagers in Bhavnagar District, Gujarat, India

Habit	Men		Women	
	No.	%	No.	%
No habit	3 648	32.4	9 325	88.1
Smoking only (any)	3 942	35.0	16	0.2
Chewing only (any)	3 124	27.7	1 242	11.7
Mawa	2 127	18.9	7	0.1
Betel quid with tobacco	171	1.5	2	–
Tobacco	799	7.1	2	–
Bajar[a]	27	0.2	1 231	11.6
Mixed habits	544	4.8	1	–
Total	11 258	100.00	10 584	100.0

From Gupta *et al*. (1998)
[a] Dry snuff

In West Bengal, 1990 women aged 16–60 years attending rural cancer detection clinics attached to a Calcutta-based cancer institute were interviewed about their tobacco and areca-nut habits (Chakrabarti *et al*., 1990). The habit usually consisted of chewing betel leaf, areca nut, slaked lime, catechu and a few flavouring agents. Sometimes women added *zarda*. A total of 23.3% reported chewing betel quid, half of whom used tobacco in the quid (Table 14).

Table 14. Prevalence of tobacco and areca-nut habits in women attending rural cancer detection clinics in West Bengal, India

Habit	No.	%
No habit	1502	75.5
Betel quid without tobacco	226	11.4
Betel quid with tobacco	236	11.9
Other habits[a]	26	1.3
Total	1990	100.0

From Chakrabarti *et al*. (1990)
[a] Other habits included drinking and chewing of anise seeds and cloves.

A study of chewing and smoking habits among 259 rural school teachers (230 men and 29 women) aged 28–63 years was conducted in Hoogly District, West Bengal (Pandey *et al*., 2001). In this population, 51% were current tobacco users and 16.2% were former users. Among the current users, 72% were predominantly smokers, while 28% preferred smokeless forms of tobacco. Some 12% of all teachers chewed betel leaves with tobacco (Table 15). A small fraction used manufactured areca-nut products such as *gutka* and *pan masala*.

(ii) *Urban studies*

The most detailed account of chewing habits was reported among 10 000 persons admitted to the clinic of the dental school in Lucknow, Uttar Pradesh. No less than 22 different betel-chewing habits were reported (Pindborg *et al*., 1967).

Dayal *et al.* (1978) presented a detailed report on chewing habits without a simultaneous smoking habit among 57 518 textile-mill workers aged 35 years and above in Ahmedabad, Gujarat (Table 16). Of all workers, 8710 (15.2%) had no oral habit, 2212 (3.8%) had a current chewing habit and 475 (0.8%) had a past chewing habit, all of them without a simultaneous smoking habit. The data show that the practice of a single chewing habit is rare.

A survey on issues pertaining to the control of oral cancer was conducted among 120 health professionals in the field of oncology from all over India, 85% of whom were men

Table 15. Prevalence of smoking and chewing habits in rural school teachers of Hoogly District, West Bengal, India

Habit	No.	%[a]
No habit	127	49.0
Smoking		
Filter-tipped cigarettes	82	[31.7]
Untipped cigarettes	75	[29.0]
Chewing		
Betel leaves with tobacco	32	[12.4]
Others[b]	17	[6.6]

From Pandey *et al*. (2001)

[a] Percentages do not add up because 66 respondents used more than one form of tobacco.

[b] Including tobacco quid (*khaini*), snuff, tobacco paste (*gudaku*), *pan masala* and *gutka*

Table 16. Prevalence of current chewing habits among 57 518 textile-mill workers in Ahmedabad, Gujarat, India

Chewing habit	No.	%
Betel quid with slaked lime, catechu, areca nut and tobacco	1335	[2.3]
Betel quid with slaked lime, catechu and areca nut	737	[1.3]
Betel quid with slaked lime	2	[0.003]
Betel quid with areca nut	3	[0.005]
Areca nut	113	[0.2]
Others	22	[0.04]

From Dayal *et al*. (1978)

and 28% of whom were under 35 years of age (Stanley & Stjernsward, 1986). Among those surveyed, 8% currently chewed betel quid with tobacco, 4% were previous regular chewers and 22% reported occasional chewing (Table 17). The prevalence of chewing was similar among men and women.

In 1992–94, a baseline survey on tobacco and areca-nut habits was conducted among 99 598 permanent residents of Mumbai, aged 35 years and above, belonging to the lower socioeconomic strata (Gupta, 1996). The prevalence of smokeless habits was high among both women and men (Table 18). Overall, areca nut in all forms was used by 29.7% of women and 37.8% of men, and betel quid without tobacco by 0.4% of men and 0.5% of women. Ten per cent of men practised both smokeless (including areca-nut habits) and smoking habits.

Table 17. Prevalence of tobacco and areca-nut habits of 120 health professionals in the field of oncology in India

Habit	Prevalence (%)				
	Current	Occasional	Past[a]	Never	Total
Cigarette	10	9	14	66	100
Bidi	0	1	1	97	100
Betel quid with tobacco	8	22	4	66	100

From Stanley & Stjernsward (1986)
[a] Past habit was defined as those having quit for at least 1 month.

Table 18. Prevalence of tobacco and areca-nut habits among permanent residents of Mumbai, India, of lower socioeconomic status

Habit	Men		Women		All	
	No.	%	No.	%	No.	%
No current habit[a]	[12 280]	[30.7]	[25 268]	[42.5]	[37 548]	[37.7]
Smokeless tobacco	18 322	45.7	34 019	57.1	52 341	52.5
Smoking	5 494	13.7	146	0.2	5 640	5.7
Smokeless tobacco and smoking	3 975	9.9	94	0.2	4 069	4.1
Total	40 071	100.0	59 527	100.0	99 598	100.0
Use of smokeless tobacco						
Mishri	[4 140]	10.3	15 740	26.5	19 880	20.0
Mishri + betel quid with tobacco	4 976	12.4	10 687	18.0	15 663	15.7
Betel quid with tobacco	5 871	14.7	3 527	5.9	9 398	9.4
Tobacco + slaked lime	2 997	7.5	640	1.1	3 637	3.7
Others with tobacco	1 144	2.9	1 200	2.0	2 344	2.4
Multiple practices	2 993	7.4	2 013	3.3	5 006	5.0
Areca nut[b]	176	0.4	306	0.5	482	0.5
No smokeless tobacco use (no habit + smoking only)	17 774	44.4	25 414	42.7	43 188	43.4
Total	40 071	100.0	59 527	100.0	99 598	100.0

From Gupta (1996)
[a] Includes about [14%] of men and [5%] of women who were former users of tobacco, mostly in the form of smokeless tobacco.
[b] Areca-nut chewing, most often as betel quid without tobacco

In a northern suburb of Trivandrum City, Kerala, two groups of men and women, 35 years of age or older, mostly of lower socioeconomic status, were interviewed in 1995–98 (Sankaranarayanan *et al*., 2000). Chewing habits, consisting mainly of betel quid with tobacco, were practised by 26.8% of men and 26.4% of women in one group and 20.5% of men and 17.6% of women in the other group (Table 19). Chewing habits were more common in low-income, low-education participants and in individuals with a manual occupation or retirees (Hashibe *et al*., 2003). Among those for whom information was available, 89% chewed betel quid with tobacco, 11% chewed betel quid without tobacco and 0.4% chewed tobacco only (Thomas *et al*., 2003).

Table 19. Prevalence[a] of tobacco and areca-nut habits among urban residents in Trivandrum, Kerala, India

Habit	Men (%)		Women (%)	
	Group I	Group II	Group I	Group II
No.	25 453	23 356	34 441	31 351
No habit	31.4	44.1	72.3	81.8
Chewing[b]	26.8	20.5	26.4	17.6
Smoking	55.8	43.9	2.4	1.0

From Sankaranarayanan *et al*. (2000)
[a] Percentages do not add up to 100% possibly because some residents reported multiple habits.
[b] Mostly betel quid with tobacco

(*b*) *Children and adolescents*

In 1992, a survey of 146 children and teenagers (84 boys and 62 girls) between the ages of 5 and 20 years was conducted in the coastal fishing community of Mariyanad, Kerala (George *et al*., 1994). Chewing of betel quid with tobacco was by far the most prevalent habit in both boys and girls, and was inversely related to level of education (Table 20). Two boys both chewed betel quid with tobacco and drank alcohol. One boy, 17 years of age, chewed betel quid with tobacco and smoked.

A survey conducted in 1998 among 400 male medical students revealed that about 12.5% were regular users of *gutka* (Table 21) and 27.5% were occasional users of areca-nut products without tobacco (Sinha & Gupta, 2001). Among those with a regular habit, about half had smokeless habits, consisting of chewing *gutka* and *khaini*. Occasional users mainly chewed areca-nut products not containing tobacco, e.g. *pan masala*.

A number of surveys conducted in households in India have shown that *pan masala* and *gutka* are commonly chewed by children and adolescents, especially in Gujarat, Maharashtra and Bihar. In a survey of 1200 students from junior and degree colleges of Maharastra, 9.9% chewed *pan masala* and 9.6% chewed *gutka*. In a survey of 95 boys and

girls in the 8th and 9th grades (13–14 years old) of a small-town private school in Anand, Gujarat, 16% used *gutka*. In a village community of Kheda District, Gujarat, 72% of men and 50% of women under 26 years of age used tobacco products. Men favoured bidis and *gutka* while women preferred *gutka* and tobacco toothpaste. Among high school students in classes 10–12 (15–17 years old) in Patna, Bihar, approximately 12% used *pan masala* (Gupta & Ray, 2002).

Table 20. Prevalence of tobacco and areca-nut habits of children and teenagers aged 5–20 years in a coastal fishing village in Kerala, India

Habit	Boys		Girls		All	
	No.	%	No.	%	No.	%
No habit	[44]	[52.3]	[52]	[83.9]	[96]	[65.8]
Betel quid with tobacco chewing						
Occasionally	12	14.3	7	11.3	19	13.0
Regularly	23	27.4	1	1.6	24	16.4
Bidi smoking						
Occasionally	–	–	2	3.2	2	1.4
Regularly	1	1.2	–	–	1	0.7
Alcohol drinking						
Occasionally	4	4.8	–	–	4	2.7
Regularly	–		–	–	–	–
Total	84	100.0	62	100.0	146	100.0

From George *et al*. (1994)

Table 21. Prevalence of tobacco and areca-nut habits of medical students in Patna, Bihar, India

Habit	No.	%
No habit	[78]	18.8
Tobacco (smoking and chewing)		
Regular	172	43.0
Smoking		20.7
Chewing		20.2
Gutka		12.5
Occasional	37	9.3
Areca-nut products without tobacco		
Regular	3	0.8
Occasional	110	27.5
Total	400	100.0

From Sinha & Gupta (2001)

1.3.2 *Pakistan*

In a study on dietary and chewing/smoking habits, data on 10 749 persons of low and middle socioeconomic status, aged 20 years and over, were collected from various districts of Karachi (Mahmood *et al.*, 1974). Overall, 27.9% of men and 37.8% of women chewed areca nut in the form of betel quid (Table 22). Of this group, 47.5% of men and 31.9% of women chewed betel quid without tobacco (Table 23).

Table 22. Prevalence of tobacco and areca-nut habits in a population sample in Karachi, Pakistan, 1967–72

Habit	Men (%)	Women (%)	Total (%)
No.	5802	4947	10 749
No habit	36.9	56.8	46.0
Pan	4.2	11.5	7.6
Tobacco chewing	2.6	1.9	2.2
Smoking	30.3	2.2	17.4
Pan + tobacco chewing	6.1	25.0	14.8
Pan + smoking	8.9	0.4	5.0
Tobacco chewing + smoking	0.7	0.1	0.5
All three habits	8.7	0.9	5.1
Unknown	1.6	1.2	1.4
Total	100	100	100

From Mahmood *et al*. (1974)

Table 23. Prevalence of *pan*-chewing habits in a population sample in Karachi, Pakistan, 1967–72

Habit	Men (%)	Women (%)	Total (%)
No *pan* habit	70.9	61.2	66.5
Without tobacco	13.3	12.0	12.7
With tobacco *qiwam*[a]	2.1	2.6	2.3
With tobacco leaf	12.3	22.5	17.0
With tobacco leaf + *qiwam*[a]	0.3	0.6	0.5
Other types	0.2	0.3	0.3
Unknown	0.9	0.9	0.9
Total	100.0	100.0	100.0

From Mahmood *et al*. (1974)

[a] *Qiwam* (also spelt *kiwam*): paste prepared from processed tobacco leaves, from which the stalks and stems have been removed, that are soaked and boiled in water with flavourings and spices, macerated and strained. The paste is chewed.

A survey was conducted in a sample of 160 primary school students aged 4–16 years (98% were < 12 years) in a fishing community on Baba Island of Karachi, Pakistan (Shah *et al.*, 2002). Of the 159 respondents, 118 (74.2%) used areca-nut products in the form of sweetened areca nut or betel quid (Table 24).

Table 24. Prevalence of areca-nut habits among primary school children (4–16 years of age) on Baba Island, Karachi Harbor, Pakistan

Habit	No.	%
No habit	41	25.8
Sweetened areca nut only	63	39.6
Betel quid only	4	2.5
Sweetened areca nut and betel quid	51	32.1
Betel quid[a] with tobacco	10	[6.2]
Betel quid without tobacco	46	[28.9]
Total	159	100.0

From Shah *et al*. (2002)
[a] Alone or in conjunction with sweetened areca nut
[The Working Group noted small inconsistencies between the text and table in the percentage of users of sweetened areca nut and the number of betel-quid users.]

1.3.3 *Bangladesh*

Prevalence patterns of use of tobacco and areca nut by Bangladeshi populations have not been published in the English language literature. Extrapolating from migrant populations originating from Bangladesh and living in the United Kingdom, it is clear that the habit of chewing areca nut with and without tobacco is very prevalent in this population (see Section 1.3.6) and may therefore be taken as evidence for the existence of the habit in the home country.

1.3.4 *Sri Lanka*

In Sri Lanka, the quid consists of fresh areca nut, slaked lime from seashells, fresh betel leaf and slightly dried (or processed) tobacco (Chiba *et al*., 1998). Studies in the early 1970s (Senewiratne & Uragoda, 1973) indicated that, among a group of healthy people, 55.6% of the men and 42.7% of the women added tobacco to the quid.

In rural Sri Lanka, the habit of betel-quid chewing is widely practised. Stephen and Uragoda (1970) reported that 30.1% of 1088 persons (men, 27.9%; women, 32.3 %) chewed betel quid with tobacco. In a large-scale study in rural Sri Lanka, it was shown that [57%] of men and women were chewers, about half of whom included tobacco in

their quid (Warnakulasuriya, 1992). In a nationwide survey conducted between 1994 and 1995 (Ministry of Health, 1998), approximately 4000 adults over the age of 35 years were interviewed on their betel-quid chewing habits. The prevalence of betel-quid chewing was [33.8%] among those aged 35–44 years and [47.7%] among those aged 65–74 years. In another study, the average number of quids used per day was 5.5 (Topcu *et al*., 2002).

1.3.5 *Maldives*

In a study of 344 schoolchildren aged 5–15 years, 31% chewed 'betel' daily, 48% chewed occasionally and 21% did not chew. The prevalence of daily chewing for ages 5–6, 10 and 15 years was 15, 27 and 51%, respectively (Knudsen *et al*., 1985). [The habit was not described in detail.]

1.3.6 *People's Republic of China*

Betel-quid chewing is popular in the south-eastern part of China, particularly in the Hunan Province and on Hainan Island (Tang *et al*., 1997). In Xiangtan City, Hunan Province, fresh areca fruit is imported from Hainan Island and is treated with maltose and lime. The nut is cut longitudinally into four or six pieces and is usually chewed with a few drops of cassia twig oil (Tang *et al.*, 1997). On Hainan Island, the fruit is chewed fresh with lime and wrapped in betel leaf (Pindborg *et al.*, 1984). In neither region is tobacco added to the quid.

An epidemiological survey was conducted in Xiangtan City in over 10 000 randomly selected subjects (Tang *et al*., 1997). Just over one third of the population sample chewed betel quid (Table 25). Among the chewers, 32% of the men and 97% of the women did not have a smoking habit.

Of 100 betel-quid chewers in the Linshui district of Hainan, 42 chewed betel quid alone, 31 chewed betel quid and smoked cigarettes, 21 chewed betel quid and smoked a

Table 25. Prevalence of tobacco and areca-nut habits among randomly selected subjects in Xiangtan City, Hunan Province, China

Habit	Men (%)	Women (%)	Total (%)
No habit	50.6	69.2	59.0
Areca nut	12.6	29.6	20.3
Smoking	10.0	0.3	5.6
Areca nut + smoking	26.8	0.9	15.1
Total	100	100	100

From Tang *et al*. (1997)

waterpipe and one chewed betel quid, and smoked cigarettes and a waterpipe. Of the 46 women surveyed, 87% chewed areca nut with no additional habit (Pindborg *et al*., 1984).

1.3.7 *Taiwan, China*

It was estimated that about 10% of the population of 2 million in Taiwan, China, chew betel quid (Ko *et al*., 1992). The ingredients of a quid vary with the area and ethnic group.

Quids in Taiwan can be classified into three types (see Table 1; Yang *et al*., 2001): *lao-hwa* quid, betel quid and stem quid. *Lao-hwa* quid prevails in urban districts, and is prepared by inserting a piece of inflorescence of *Piper betle* L. with red lime paste (slaked lime and some local flavouring) into an unripe areca nut. The second most popular quid is betel quid made by wrapping a split unripe areca nut and white slaked lime paste in a piece of betel leaf, and is popular in urban and aboriginal areas. Betel quid is always chewed without tobacco. The third type of quid, stem quid, is similar to lao-hwa quid except that the piece of inflorescence of *Piper betle* L. is replaced by a piece of stem of *Piper betle* L. The use of stem quid is rare and only seen in southern parts of aboriginal areas, primarily in the Paìwan and Yamì tribes.

Table 26 summarizes a series of surveys on the prevalence of chewing habits in Taiwan, China.

Inhabitants of Kaohsiung of all ages and individuals from three aboriginal tribes (Paìwan, Rukai and Bunun) over 15 years of age were interviewed in their home in a house-to-house survey (Ko *et al.*, 1992). Among the inhabitants of Kaohsiung, the prevalence of chewers was higher in men, older people, blue-collar workers, smokers, drinkers and less educated people; of the chewers, 86% were smokers and 75% were drinkers. Both men and women had chewed an average of 14 portions a day for an average of over 14 years. Among aboriginal people, prevalences were 42.1% for current betel-quid chewers (46.5% for men; 38.0% for women) and about 1% for former chewers for both men and women. No significant differences with respect to level of education or occupation were found. Of the chewers, 36% were smokers and 55% were drinkers; 55% used betel quid with men having chewed on average 23 portions a day for over 11 years and women 16 portions a day for over 7 years.

Another survey on betel-quid chewing among residents in Kaohsiung aged 15 years and above gave similar findings (Chen & Shaw, 1996).

A population-based survey of an aboriginal community of southern Taiwan, China, was conducted in 1997 and included 312 participants aged 20 years or older (Yang *et al*., 2001). The lifetime prevalence of chewing was 89.4%, with 69.5% for current chewers. The prevalence in women (78.7%) was higher than that in men (60.6%). The rates in young subjects were similar to those in the elderly. Betel quid was the predominant type (65%), followed by stem quid (57%); only 11% of people used *lao-hwa* quid. The average duration of chewing was 22 years for men and 26 years for women, and the average number of portions per day was 17.3. Almost half of the chewers also had smoking and/or drinking habits.

Table 26. Surveys on the prevalence of betel-quid chewing in Taiwan, China

Reference	Study population	Chewing habit[a]	Chewing category	Prevalence (%)	Comments
Ko *et al.* (1992)	1299 residents of Kaohsiung and 827 aborigines from three tribes	*Lao-hwa*; *lao-hwa* + smoking; betel quid; betel quid + smoking		*Kaohsiung inhabitants*	Information on intensity and duration available for both groups and both sexes
			Former chewer	4 (6.7 M, 1.3 F)	
			Current chewer	6 (9.8 M, 1.6 F)	
				Among chewers:	
			Lao-hwa	10.6 M, 40.0 F	
			Lao-hwa + smoking	86.4 M, 60.0 F	
			Betel quid	0 M, 0 F	
			Betel quid + smoking	3.0 M, 0 F	
				Aborigine tribes	
			Former chewer	1.0 (1.3 M, 0.7 F)	
			Current chewer	42.1 (46.5 M, 38.0 F)	
				Among chewers	
			Lao-hwa	18.9 M, 33.7 F	
			Lao-hwa + smoking	33.5 M, 3.1 F	
			Betel quid	22.7 M, 55.8 F	
			Betel quid + smoking	24.9 M, 7.4 F	
Lu *et al.* (1993)	2367 students in junior high school in Changhua	*Lao-hwa*; betel quid	Chewer	4.7 (9.2 M, 0.7 F)	53.6% of students that chewed first experimented with a family member.
			Grade (mean age)	Seventh (12.5): 1.2	
				Eighth (13.6): 4.2	
				Ninth (14.5): 8.7	
			Residential area	Village: 6.5	
				Town: 3.7	
				City: 3.0	
			Achievement level	Ordinary: 8.4	
				High: 1.6	
			Family member chewing	None: 2.4	
				≥ 1: 7.0	
			Among chewers		
			Lao-hwa	87.5	
			Betel quid	12.5	
Chen & Shaw (1996)	1162 residents (511 M, 651 F) of Kaohsiung aged ≥ 15 years	Betel quid	Casual chewer	10.5 (21.9 M, 1.4 F)	
			Daily chewer	2.8 (6.5 M, 0 F)	
			Ever chewer	13.3 (28.4 M, 1.4 F)	
Yang *et al.* (1996)	3185 students (1581 M, 1604 F) in a junior high school (13–15 years old) and 1325 students (1083 M, 241 F) in a vocational school (16–18 years old) located in southern Taiwan	Betel quid		*Junior high school*	Prevalence of betel-quid chewing increased with tobacco use, alcohol use and friendship with other betel-quid chewers
			Current chewer	1.9 (3.4 M, 0.4 F)	
			Former chewer	14.0 (24.4 M, 5.0 F)	
			Ever chewer	15.9	
				Vocational high school	
			Current chewer	10.2 (12.5 M, 0 F)	
			Former chewer	31.0 (36.1 M, 8.3 F)	
			Ever chewer	41.2	

Table 26 (contd)

Reference	Study population	Chewing habit[a]	Chewing category	Prevalence (%)	Comments
Chong *et al.* (1999)	774 junior high school students (14–16 years old)	Betel quid	Chewer Residential area	2.2 (4.4 M, 0.3 F) Urban: 1.3 Suburban: 1.1 Rural: 5.0	
Ho *et al.* (2000a)	2572 students in senior high schools (16–18 years old) in southern Taiwan (Kaohsiung and Pingtung areas)	Betel quid	Type of school General Commercial Medical technician Manufacturing Agricultural	*Ever chewer* 4.7 (8.0 M, 0.8 F) 6.9 (33.3 M, 5.2 F) 16.3 (33.3 M, 9.9 F) 25.6 (31.2 M, 4.8 F) 31.3 (40.1 M, 14.2 F)	
Ho *et al.* (2000b)	2087 junior high school students (13–15 years old), including 82 students from the aboriginal area in Taichung County	Betel quid	 Current chewer Former chewer Current chewer Former chewer	*Overall* 5.4 6.8 *Aboriginal area* 30.1 21.7	Information on time and location of first chewing experience
Chen *et al.* (2001)	6318 residents (3188 M, 3130 F) of I-Lan aged 13–35 years	Betel quid	Overall 13–15 years 16–18 years 19–22 years 23–35 years Aborigines Non-aborigines	15.5 M, 1.3 F 3.0 M, 0.4 F 6.8 M, 0.4 F 12.1 M, 1.3 F 23.9 M, 2.0 F *Ethnic group* 23.8 (35.3 M, 12.8 F) 7.4 (14.2 M, 0.5 F)	Prevalence of betel-quid chewing increased with tobacco use, alcohol use, illicit drug use and lower education
Yang *et al.* (2001)	312 randomly selected subjects (119 M, 193 F) aged ≥ 20 years, aboriginal community in southern Taiwan	Betel quid; stem quid; *lao-hwa*	No chewing Chewing only Chewing/drinking Chewing/smoking Chewing/smoking/drinking Current chewer Betel quid Stem quid *Lao-hwa*	[9.3] [47.8] [13.1] [17.0] [12.8] 69.5 (60.6 M, 78.7 F) Among chewers: 64.9 (61.9 M, 67.8 F) 56.6 (53.7 M, 59.4 F) 10.5 (13.1 M, 8.0 F)	See also Section 2
Kuo *et al.* (2002)	905 junior high school students (458 M, 447 F) (12–17 years old) in Taipei City	Betel quid	Grade 7 Grade 8 Grade 9	3.1 (3.5 M, 2.8 F) 2.7 (2.7 M, 2.7 F) 6.6 (12.3 M, 1.2 F)	

[a] Betel quid is always without tobacco.

Adolescents

Using a random sampling design that stratified for district (village, town and city), level of achievement (ordinary versus high), sex and grade, another survey selected 2367 students aged between 12 and 15 years (Lu *et al*., 1993). The overall prevalence for areca-nut chewing was 4.7%. The prevalence was much higher in boys than in girls, increased with age and decreased with increasing achievement level. Students in village districts had the highest prevalence, followed by those in town and city districts. Also, students with at least one family member who chewed areca nut had a higher prevalence than those with none. Of the chewers, 40.5% were smokers and 21.5% were drinkers. Most chewers used *lao-hwa*.

One study aimed at surveying adolescents was conducted by sampling students from a junior high school and a vocational school (Yang *et al*., 1996). The prevalence of chewing betel quid was higher among students in the vocational school, among boys, and was related to alcohol use, smoking, drug use and low academic achievement. Male students with the habit of drinking (odds ratio, 4.4; 95% confidence interval [CI], 3.0–6.4 for junior high school; odds ratio, 3.2; 95% CI, 2.0–5.4 for vocational school) or smoking (odds ratio, 9.6; 95% CI, 6.7–14.1 for junior high school; odds ratio, 16.0; 95% CI, 9.8–26.1 for vocational school) were more likely to chew betel quid than those who did not. Junior high school students who had classmates or friends who chewed betel quid had a fivefold higher risk (odds ratio, 5.3; 95% CI, 3.2–8.7) and vocational school students had a fourfold higher risk (odds ratio, 3.8; 95% CI, 2.1–6.8) of chewing betel quid compared with those who did not.

A cross-sectional study was designed to estimate the prevalence of betel-quid chewing for students in five types of senior high schools, one general school and four vocational schools (Ho *et al.*, 2000a). The prevalence in the general school was lower than that in all vocational schools. Among the latter, the highest prevalence was found in the agricultural school, followed by the manufacturing school, medical technician school and commercial school.

Ho *et al*. (2000b) conducted a cross-sectional survey to explore the betel-quid chewing behaviour of junior high school students in Taichung County. The prevalences of current chewers among non-aboriginal students from different areas were 4.0–5.0%. Much higher prevalences were found for current and former chewers among aboriginal students.

In I-Lan (Chen *et al*., 2001), a northern county of Taiwan, China, the prevalence of betel-quid chewing increased significantly ($p < 0.001$) with age, was higher among aboriginal people compared with non-aboriginal people and was higher among those with lower levels of education.

Junior high school students from Taipei City were asked to complete a questionnaire on substance use (Kuo *et al.*, 2002). Alcoholic beverages were the most frequently used, followed by smoking and areca-nut chewing. There was a sharp increase in areca-nut chewing among boys between grade 8 and grade 9. For all subjects, lower levels of

parental education and poorer school competence were associated with higher prevalence of use of areca nut.

1.3.8 *Myanmar*

Lay *et al*. (1982) briefly described a betel quid known as 'kun-ya' or 'kun', as 'containing the betel nut-areca nut and other ingredients'. Sein *et al*. (1992) stated that 'there are different patterns of chewing among chewers. The most common form is chewing betel quid which usually consists of a leaf of betel-vine, areca nut, slaked lime and some aroma. Many of the chewers used tobacco in betel quid but some chewed without it.'

1.3.9 *Thailand*

The main constituents of betel quid in Thailand are similar to those found elsewhere in South-east Asia. The leaf of *Piper betle* L., areca nut, lime prepared from limestone or seashells, cutch (catechu) and frequently air- and sun-dried tobacco make up a quid (Simarak *et al*., 1977). There are, however, a number of variations in betel-quid chewing in Thailand (Reichart, 1995).

Mougne *et al*. (1982) studied smoking, chewing and drinking habits in northern Thailand. These authors confirmed that the main constituents of the betel quid included areca nut, betel vine and slaked lime. Commonly used additives are cutch, *nang ko*, *dok can* — sandalwood or moonflower bark — and tobacco. Only 2.6% of participants reported occasional betel-quid chewing and 6.8% used it daily. Regular, current chewers were almost entirely men and women over the age of 50 years: 22.7% of women and 18.4% of men in that age range chewed betel quid daily. Nearly all regular chewers consumed between one and seven quids per day. All chewers used betel leaf, slaked lime and *nang ko*; 6% did not use areca nut; 83% used tobacco, 65% used cutch and 2% used *dok can* as further additives. Most chewers used dried areca nut and dried betel leaf. However, fresh nut and leaf were accepted by 30% of the betel-quid chewers.

From 1979 to 1984, Reichart *et al*. (1987) carried out a study among northern Thai hill tribes (Lahu, Karen, Lisu, Meo) and rural Thai. Prevalence of the betel-quid chewing habit was reported to be 5–44% in men and 9–46% in women. The habit was less predominant among rural Thai than among hill tribes. The Meo tribe did not practise betel-quid chewing; instead, the habit of chewing *miang* (fermented wild tea leaves) was preferred.

The habit of betel-quid chewing seems to be on the decline in Thailand. Reichart (1995) observed that only very few villagers below the age of 35 chewed betel quid, once a universal custom among the Thai. Also, the betel-quid chewing habit has almost vanished from large cities such as Bangkok or Chiang Mai. Axéll *et al*. (1990) reported that only 3/234 (1.3%) individuals attending the Chiang Mai Dental Faculty reported any use of betel quid. A study on 385 Thai dental students' knowledge of the chewing habit in Thailand revealed that only 62.6% considered this habit as typical for Thailand. It was

widely accepted that betel-quid chewing is more common in the provinces (83.6%) and that it is a habit of the elderly (92.2%). The decline in the habit was also demonstrated by the fact that 96.1% of the students' parents and 62.3% of their grandparents did not indulge in the habit. Less than 8% of the students themselves had tried betel quid and none indulged in the habit (Reichart *et al*., 1999).

1.3.10 *Lao People's Democratic Republic*

Asma (1997) reported on smokeless tobacco in the form of betel-quid chewing among women. The betel quid was reported to consist of areca nut, betel leaf, slaked lime and tobacco. In Lao People's Democratic Republic, betel leaf is smeared with slaked lime, and areca nut and finely cut tobacco are added to the quid, a procedure identical to that in neighbouring countries. Interestingly, camphor is used to remove red stains from the teeth after chewing. The report also mentions 'bark of a certain tree' as an ingredient of betel quid. No epidemiological studies on the betel-quid habit in this country are available.

1.3.11 *Cambodia*

Len Meng (1969) described in detail the habit of betel-quid chewing in Cambodia. The betel quid is composed of areca nut, betel leaf and slaked lime; tobacco is frequently added. Ikeda *et al*. (1995) published a prevalence study of oral mucosal lesions in 1319 individuals (953 women, 366 men) aged 15–99 years: 31.2% were betel-quid chewers, with a prevalence of 40.6% in women and 6.8% in men. A study of 102 rural Cambodian women who chewed betel quid, aged 39–80 years, and their family members revealed that betel-quid chewing is popular mainly among elderly women while younger people do not seem to have taken up this habit (Reichart *et al*., 1996). This was confirmed in a later study (Reichart *et al*., 2002). When questioned about betel-quid chewing habits in Cambodia, 95 Khmer medical and dental students, none of whom indulged in this habit, had poor knowledge on the subject. Betel-quid chewing was practised by 5.3% of their parents and 40% of their grandparents, thus indicating a declining prevalence. Most students agreed that betel-quid chewing is a habit of elderly women (Reichart *et al.*, 1997).

1.3.12 *Malaysia*

Chin and Lee (1970) studied the chewing habits of 212 Indian and 84 Malay betel-quid chewers. The betel quid used by 167 Indian subjects consisted of young betel leaf, slaked stone lime, tobacco and powdered or sliced, dried areca nut, while 45 chewed betel quid without tobacco. Among the Malays, 45 used a betel quid consisting of a more mature betel leaf, *gambir*, slaked stone lime and fresh areca nut without tobacco and 39 chewed without *gambir*.

Gan (1998) studied tobacco use and other oral habits among rural Bajau women in Sabah: 80.2% of the women had some type of chewing habit (Table 27); 77% of the

Table 27. Prevalence of tobacco and areca-nut habits among Bajau women in Malaysia

Habit	No.	%
No habit		[16.5]
Chewing		
Tobacco, betel leaf, areca nut, lime, *gambir*	183	42.4
Tobacco, betel leaf, areca nut, lime	137	31.8
Tobacco, betel leaf, areca nut	1	0.2
Tobacco, lime	3	0.7
Tobacco, areca nut	2	0.5
Tobacco only	6	1.4
Various combinations without tobacco	14	3.2
Smoker (daily and occasional)		3.3
Total	431	100.0

From Gan (1998)

women used smokeless tobacco compared with 4.3% of the men. The prevalence of tobacco in betel quid increased with increasing age.

In a recent study conducted among adults of six Malaysian estates, 114 of 618 subjects were current betel-quid chewers. The habit was more prevalent among women: 76.3% of the chewers were women and 23.7% were men (Tan *et al*., 2000).

1.3.13 *Singapore*

Among Singaporeans, betel-quid chewing is still practised by some of the older Indian people and Malay women (Cheong, 1984). Kuek *et al*. (1990) also reported the tradition of betel-quid chewing among the Indian community, which represents 6.4% of the entire population. The quid consists of areca nut, betel leaf, slaked lime and a variety of seeds (sesame, clover) and aromas. *Pan masala* is also available on the market.

1.3.14 *Indonesia*

Möller *et al*. (1977) described the composition of the betel quid in Indonesia as usually comprising areca nut, betel leaf and slaked lime. Catechu may also be added. Spices such as cardamom or clove may be added for flavour. In most parts of Indonesia, tobacco does not constitute an ingredient of the betel quid itself. Rather, after the betel quid has been chewed for several minutes, a lump of fine-cut tobacco is placed in the labial commissure and finally used to clean the teeth (IARC, 1985a). The habit of betel-quid chewing is more common in women than in men, and is more prevalent in women over the age of 35 compared with those under 35 years of age. The habit is usually acquired between the ages of 15 and 20 years. Recently, Budhy *et al*. (2001) speculated that the habit of chewing betel quid may be dying out in Indonesia.

1.3.15 *The Philippines*

According to Davis (1915), betel-quid chewing was an almost universal habit in elderly persons in the Philippines around the turn of the last century. The betel quid *buyo* consisted of betel leaves, areca nut, slaked lime and tobacco, or combinations of these constituents. [No recent data were available to the Working Group.]

1.3.16 *Papua New Guinea*

Several types of areca palm are recognized in Papua New Guinea, and their nuts differ in appearance, flavour and strength. Areca nuts are used at all stages, from young and green (preferred) to old, dry and germinating. They are chewed raw and are not cured (MacLennan *et al*., 1985).

One of the earliest reports describing the habit of areca-nut chewing in Papua New Guinea was by Atkinson *et al*. (1964). The method of chewing is relatively uniform throughout the country, with some occasional minor differences. The nut is chewed when it is either ripe or half ripe, and is chewed in association with slaked lime obtained either from shells or from coral. The lime preparation consists of slaked lime and calcium oxide with some traces of calcium carbonate. In addition, in many areas, wild ginger is added together with betel leaf and/or betel inflorescence; these additions are optional. The method of chewing involves first chewing the nut, then adding slaked lime from a hollow gourd container by means of a dipping stick. The slaked lime-coated stick is wiped against the buccal mucosa and the slaked lime is often entirely removed from the stick when the latter is withdrawn from the mouth between the lips. The mixture then becomes deep red in colour. The slaked lime, as well as the betel leaf and other ingredients, are added more or less continually, according to preference. Tobacco is not added to the betel quid at any stage (Atkinson *et al*., 1964). In a more recent report, MacLennan *et al.* (1985) confirmed that, in contrast to most of Asia, unwrapped betel quids are used and tobacco is never added to the mixture.

The habit of betel-quid chewing begins early in life. In one survey, the average starting age was just under 3 years, although the amounts used were small until the age of about 12. On a different part of the coast, the average starting age was just under 5 years (Atkinson *et al*., 1964).

Pindborg *et al*. (1968) examined 1226 Papua and New Guinean villagers. Coastal villagers indulged heavily in areca-nut chewing: 81.4% on the south coast and 95.4% on the north coast chewed areca nut, compared with 26.8% in the highlands. In the coastal regions, the same prevalence was found among men and women, whereas among highlanders, the habit was seen almost exclusively among men.

Many subsequent investigations in Papua New Guinea have confirmed the habit of areca-nut chewing with lime described above (Cooke, 1969; Scrimgeour & Jolley, 1983; Jamrozik, 1985; Talonu, 1989; Martin *et al*., 1992; Thomas & MacLennan, 1992).

De Costa and Griew (1982) studied betel-quid chewing in pregnant women in Papua New Guinea. None of 400 consecutive mothers, each of whom had made at least one ante-

natal visit, smoked or drank alcohol but all gave an unambiguous history of having chewed betel quid daily throughout pregnancy. It was not possible to quantify the amount of betel quid consumed.

1.3.17 *Palau*

In Palau, areca nut is chewed in the green unripe state. It is split in half and slaked lime from fire-burned coral is placed in the centre portion of one of the halves. Tobacco which, although now imported, used to be grown on the island, and, less frequently, ginger root or other substances may also be added. These combined ingredients are wrapped in a piece of betel leaf. The excessive saliva produced by chewing this concoction is orange-red in colour and is spat out on the ground or into a spittoon. Throughout Palau, sets of ingredients for a single chew are sold in many retail stores. These sets consist of half an areca nut, some lime, a piece of betel leaf and half a cigarette, all wrapped in aluminium foil (Ysaol *et al*., 1996).

All residents of Palau aged 90 years or over (n = 31) were interviewed about their chewing habits (Jensen & Polloi, 1988). All had chewed areca nut regularly during their lifetime, but three had quit. Edentulous subjects pulverised the nut prior to use. Twenty-one of 28 current chewers included tobacco in their quid (Table 28).

A study was conducted in Palau in 1995 on a sample of 1110 residents aged 5 years or more in Koror and Airai states (Ysaol *et al*., 1996). The population sample included more than 5% of each age group and represented 7.9% of the entire population. The proportion of chewers did not differ significantly between age groups, except for the 5–14-year-olds (Table 29). Between 58% and 96% of the respondents in the different age groups added tobacco to the quid, with 87% in the youngest age group. The two youngest age groups reported using significantly less betel leaf. The possible explanations were that

Table 28. Areca-nut and tobacco habits among the very old (≥ 90 years) population of Palau

Habit	No.
Betel-quid chewing	
Current user	28
Former user	3
Current user	
With tobacco	21
Without tobacco	7
Cigarette smoking	
Current smoker	1
Nonsmoker	30

From Jensen & Polloi (1988)

Table 29. Proportion of betel-quid chewers and of ingredients used among residents of Palau

	Proportion chewing (%)	Proportion (%) of chewers using		
		Betel leaf	Slaked lime	Tobacco
Age (years)				
5–14	55	48[a]	99	87
15–24	77	51	99	96
25–34	86	84	100	88
35–44	89	94	99	72
45–54	82	96	99	68[a]
55–64	77[a]	100	100	58[a]
65–74	86[a]	96	100	65[a]
> 74	84[a]	100	100	76[a]
Men	72	73	100	81
Women	80	75	99	84
Total no.	845	624	840	700

From Ysaol *et al*. (1996)
[a] Maximum error exceeds 9% at $p < 0.05$. All other proportions have a maximum error of less than 9% at $p < 0.05$.

adolescents have less access to the sometimes scarce leaf or they may wish to avoid the reddened saliva and stained teeth caused by chewing the leaf to escape detection of their habit by disapproving authorities and institutions.

1.3.18 *Guam*

Chewing areca nut (*pugua*) is an old tradition in Guam, particularly among the native Chamorro people (Gerry *et al.*, 1952). Islanders prefer the hard reddish variety of nut but citizens of Micronesia prefer a soft (unripe) areca nut that is succulent and gelatinous (Anon., 2003).

Another account of the chewing habits of Guamanians in 1986 reported that indigenous people chewed either the entire fresh green areca fruit (nut, husk and skin) or the areca nut together with betel leaf. Slake lime is not used during chewing, nor is tobacco (Stich *et al.*, 1986). A comparison with previous reports indicated that this practice had not changed over the last 40–50 years.

1.3.19 *Others*

In various countries, including Nepal, Viet Nam, Kenya and the Solomon Islands, the habit of chewing betel quid or areca nut is known, but no reports are available.

1.3.20 *Migrant populations*

Population migration brings a wide variety of traditional products into cultures that were hither to unfamiliar with them. Examination of chewing habits among Asian migrants has shown that the use of areca nut alone or in the form of *pan masala* and *gutka* is prevalent in these communities and that the patterns of use are very similar to the local chewing customs prevalent in their country of origin (Warnakulasuriya *et al*., 2002). Available data on the prevalence of areca-nut chewing among the migrant populations in South Africa and the United Kingdom are reviewed here. The prevalence of areca-nut use by Indian migrants to the Malay peninsula is described in earlier sections under the relevant geographical region.

(*a*) *South Africa*

The habit of areca-nut chewing was introduced into South Africa by Indian immigrants in 1860 (Choonoo, 1967). The commonest way to prepare the betel quid is similar to that described for India (Schonland & Bradshaw, 1969). However, the nut is often chewed alone, and red, white or black nuts are preferred by different chewers. Roasted areca nut is preferred. Tobacco is added as a small quantity of coarse shreds by a small minority of chewers, mainly men. Other additives include slaked lime, catechu and flavouring agents. Men and women chewers differ little in their chewing preferences (Table 30).

Shear *et al*. (1967) and Dockrat and Shear (1969) examined the habits of chewing areca nut and betel quid (with or without tobacco), the use of tobacco (smoking) and the intake of snuff among Indian residents (729 men, 1471 women) in the Pretoria–Johannesburg area and in metropolitan Durban. Overall, 912 subjects had a chewing habit, of which 13.7% were men and 86.3% were women. The youngest chewer was aged 2.5 years and the oldest was aged 98 years. The chewers of areca nut or betel quid represented 17.1% of the men and 53% of the women in the population sample.

Table 30. Prevalence of areca-nut and betel-leaf chewing habit among chewers in Durban, South Africa

Habit	Men (n = 77)	Women (n = 479)
Chewing habit		
Betel leaf only	5.2	2.9
Areca nut only	29.9	28.8
Areca nut + betel leaf	64.9	68.3
Ingredients added		
Lime	64.9	63.4
Tobacco	7.8	2.8
Catechu	32.5	14.2

From Schonland & Bradshaw (1969)

Schonland and Bradshaw (1969) undertook a survey amongst Natal Indians with special reference to betel-quid chewing habits. Of 1842 women of all ages, 30.7% were chewers, while of 1836 men, 5.5% were chewers. The percentage of chewers increased with age in both men and women, 71.9% of women and 10.3% of men aged 60 years or more chewed. Although the mean age at which chewing started was between 20 and 24 years, women started marginally earlier than men. Two-fifths of chewers began the habit before the age of 20 years and a negligible number after the age of 40 years. Also, more women were heavy chewers (four or more times a day) and more men were light or occasional chewers (1–6 times a week). No significant age differences were noted in frequency of chewing, and no significant sex differences in the mean duration of the habit.

Seedat (1985) and Seedat and Van Wyk (1988) described chewing habits in a random sample of 2058 Indian residents of Durban: 186 subjects (9%) were chewers, among whom 162 chewed betel quid without tobacco and 67 chewed more than six times per day. Most chewers swallowed the juice after chewing. The ratio of women to men among chewers was 13:1, and women chewers outnumbered men in all age groups.

In a survey among 78 South African Indian chewers (77 women and one man) aged 19–77 years, four used the raw nut, 39 preferred it boiled and 34 preferred it baked. One woman chewed a nut that could not be identified (Van der Bijl & Van Wyk, 1995).

(*b*) *United Kingdom*

Commercially prepared, small foil-packaged products — *pan masala* or gutka — and raw areca nut with other ingredients are readily available through small businesses throughout the United Kingdom, mostly where Asians live (Chauhan, 2000). Several population studies conducted among Asian ethnic minority groups resident in the United Kingdom are reviewed below.

The term ‘Asians in Britain’ refers to people from the subcontinent of India, Pakistan, Bangladesh and Sri Lanka and to people from East Africa whose families originated in the Indian subcontinent. They constitute almost 3% of the total British population. There is a concentration of Asian ethnic minority groups in some areas of Britain, particularly in Inner and Greater London, West Yorkshire and the West Midlands. The majority of the recently reported prevalence studies examining chewing habits among British Asians have originated from these regions. Just under one half of the Asian ethnic minority population as a whole was born in the United Kingdom and some of these studies have examined chewing patterns of adolescents and young people.

Table 31 summarizes the areca-nut and betel-quid chewing habits recorded from several adult Asian migrant communities living in Britain (Summers *et al*., 1994; Bedi & Gilthorpe, 1995; Atwal *et al*., 1996; Pearson *et al*., 1999; Shetty & Johnson, 1999; Mannan *et al.*, 2000; reviewed in Warnakulasuriya, 2002). It is recognized that the sample sizes used for most of these studies are small and many studies interviewed selected community groups that could be labelled as convenient samples, thereby introducing biases related to sampling and data collection. It is clear from the studies that sampled the British Bangladeshi population (Summers *et al.*, 1994; Bedi & Gilthorpe, 1995; Pearson *et al*.,

Table 31. Prevalence of areca-nut and betel-quid chewing among adult Asian migrant ethnic groups resident in the United Kingdom

Region	No. of samples	Community	Habit	Prevalence (%)
Yorkshire	296	Bangladeshi, women	*Pan masala*	4
			Betel quid	95
			Betel leaf	100
			Areca nut	97
			Lime	90
			Tobacco	69
			Zarda	27
Birmingham	334	Bangladeshi, men and women	Betel quid[a]	
	158		Men	92
			Women	96
			With tobacco	
			Men	37
			Women	81
London, East	158	Bangladeshi, men and women	Betel quid[a,b]	78
	993		Betel quid with tobacco	75
London, West	181	Mixed Asian	Betel quid[a]	47
			With tobacco	
			Men	33
			Women	5
London, North-West	367	Mixed Asian	Betel quid[a]	27
			Men	27
			Women	27
Leicester	519	Mixed Asian	Betel quid[a]	33

Adapted from Mannan *et al.* (2000); Warnakulasuriya (2002)

[a] Betel quid with or without tobacco

[b] More women than men added tobacco to the quid.

1999; Mannan *et al.*, 2000) that their betel-quid chewing habits are widespread (75–96%), whereas the prevalence of the habits is lower among mixed Asian groups (27–47%).

Three studies (Osman *et al*., 1997; Farrand *et al*., 2001; Prabhu *et al*., 2001) that examined the betel-quid chewing habits among Asian adolescents living in Britain suggest that the habit is prevalent at a young age (Table 32). The majority of the younger age groups were occasional chewers. However, on reaching school-leaving age, they had become regular users of areca nut and often added chewing tobacco to the quid mixture. Longitudinal studies involving young persons have not been reported.

Comparison of chewing and tobacco habits among first- and second-generation Asian men living in Leicester suggests that betel-quid chewing habits and use of tobacco are continued by cultural bonding long after migration of ethnic groups (Vora *et al*., 2000).

Table 32. Prevalence of areca-nut and betel-quid chewing by adolescent Asian ethnic groups resident in the United Kingdom

Reference	Region	No. of samples	Age range (years)	Community	Habit	Prevalence (%)
Osman *et al.* (1997)	Luton	1058	11–16	Mixed Asian	Betel quid[a]	44
Farrand *et al.* (2001)	London, East	204	12–18	Bangladeshi	Betel quid[a]	28
					Men	30
					Women	27
					With tobacco	12
Prabhu *et al.* (2001)	London, East	704	11–15	70% Bangladeshi	Areca nut	77

[a] Betel quid with or without tobacco

Examining distinct ethnic groups interviewed in this study, it is clear that Sikhs from either the first or second generation do not indulge in tobacco or betel-quid chewing while the Hindus from both generations continue chewing betel quid or *pan masala* in their country of residence. Muslims and Jains of the second generation, on the other hand, were less likely to chew these products.

(i) *Tobacco in betel quid*

In the three studies of adolescents quoted above, the majority began chewing betel quid without tobacco but some converted to adding tobacco to the quid during senior school ages or used commercially packaged products, which predominantly contained areca nut and tobacco (*gutka*). The social pressures on young Bangladeshi women in the United Kingdom to introduce chewing tobacco to their betel quid are presented by Bedi and Gilthorpe (1995). Among older Asian adults, up to 50% are recorded as adding tobacco to the betel quid when this was made up at home according to their own recipe. For older Bangladeshi women, it may reach close to 90% (Rudat, 1994; Bedi, 1996). A further proportion predominantly chewed sweetened tobacco products such as *zarda*. With the emergence of commercially packaged areca products, it is increasingly difficult to disentangle the effect of tobacco, as these products are often mixtures of sun-dried tobacco and cured areca nut.

(ii) *Determinants of chewing habits among Asians*

Ethnic variations in the chewing of betel quid and tobacco among Asian migrants in the United Kingdom are recognized in several studies. The predominant group retaining chewing habits in Britain are Bangladeshi adults (Williams *et al*., 2002). Socioeconomic status and education certainly seem to have effects on the prevalence of the habit. Among Indians, people who are educated beyond the age of 16 years are more likely to chew

products containing tobacco, while the reverse effect was found in the Bangladeshi group (Khan *et al.*, 2000). Sex differences are small (Shetty & Johnson, 1999) and recent data indicate that chewing practices have extended to second-generation Asians born in Britain (Osman *et al*., 1997; Vora *et al*., 2000).

(*c*) *Others*

There are no population prevalence studies on areca-nut chewing habits among migrants settled in other western countries.

In North America, reports on chewing areca nut or betel quid are limited. Pickwell *et al.* (1994) reported on 10 women refugees from Cambodia in California indulging in the habit of chewing. One Canadian publication refers to a 4-year-old child who developed oral submucous fibrosis following areca-nut use (Hayes, 1985).

1.3.21 *Placement of the quid in the mouth*

The entire oral environment is likely to be exposed to the effects of chewing substances. However, the quid may be in close contact with the oral mucosa for prolonged periods and the site of placement of the quid may correspond to the site of oral lesions.

Areca nut and betel quid are masticatory substances chewed and often retained in the mouth in the lower buccal sulcus and retromolar areas.

In Papua New Guinea, slaked lime is applied to the buccal mucosa and the oral commissure during the chewing of areca nut.

1.4 Regulations and legislation

Regulations and legislation on commercial products containing areca nut have largely been overlooked until recently. The ready availability of pre-packaged mixed areca products and free access suggest the desirability of regulation. Raw areca nut available for personal consumption (Croucher & Islam, 2002) and for export in 50–100-kg sacks can be located on the internet.

Areca is usually listed as an edible fruit and is therefore normally sold as a food substance, although its food value is uncertain. It is also claimed to be a mouth freshner. Other minor uses include its supposed medicinal values as an anti-parasitic agent, through a popular belief that the consumption of areca compounds after a meal assists the digestion of food and its traditional use as a toothpaste. In China, areca nut is used in traditional Chinese medicine and is not regulated.

Any regulations related to the import and sale of areca nut in non-producing countries have to be determined by the Food Safety Acts of individual countries. Foods imported from another country that are intended for human consumption must meet the general food safety requirements (e.g. from the Food and Safety Acts in the United Kingdom). In general, these requirements are that any food item must not be: (*a*) rendered injurious to health; (*b*) unfit for human consumption due to contamination and adulteration.

Regulation of import and sale of areca-containing products

(*a*) *India*

On 1 August 2002, the Commissioner for Food and Drug Administration and Food (Health) Authority, Maharashtra State (Sharma, 2002), issued a gazette notification banning the manufacture, sale and storage of *gutka* and *pan masala* or any similar product containing or not containing tobacco. The law was enforced based on the powers conferred by Clause iv of Section 7 of the prevention of Food Adulteration Act of 1954 in the interest of public health, and the prohibition of these food articles will remain in force for a period of 5 years.

In India, a warning label is required on commercial areca-nut and tobacco products, but there are no regulations about the size of the letters. *Gutka* has been banned by several state governments: Tamil Nadu, Adhra Pradesh and Goa. Several other states are at various stages of passing laws to ban *gutka* or are in court after being challenged by the industry. A recommendation that gutka should be banned nationwide has been made to the central government by the Central Committee on Food Safety.

(*b*) *North America*

Areca nut figures on the list of herbs that are unacceptable as a non-medicinal ingredient in oral use products (Health Canada, 1995). The sale of areca products has been banned in Canada as a result of the link between arecoline and mutagenic effects (see Section 4.4.2(*a*)(iv)). The US Food and Drug Administration maintains an import alert within the USA, the main concerns being adulteration and addition of unsafe food additives (Croucher & Islam, 2002). In 1976, the US Government announced a ban on interstate traffic of areca nut (Burton-Bradley, 1978).

(*c*) *European Union*

Within the European Union (excluding Sweden), there is legislation banning the sale of tobacco products for oral use, particularly those presented in sachet portions or porous sachets, with the exception of those intended to be smoked or chewed. However, there are no specific laws regulating or banning the sale of areca products, even when mixed with smokeless tobacco, as chewing tobacco is excluded from the directive (Council of the European Communities, 2001).

United Kingdom

In the United Kingdom, there is no law to regulate the import or sale of products containing areca nut and at present numerous areca preparations, with or without tobacco, are commercially available (Bedi, 1996; Vora *et al*., 2000). The Department of Trade and Industry classifies these products as sweets (Hogan, 2000). Labelling and a list of ingredients on the packaging are sometimes non-existent. Several studies have shown that, in most outlets, sales are unrestricted to minors (Shetty & Johnson, 1999; Warnakulasuriya *et al*., 2002). A study by Trading Standards Officers in Birmingham revealed that children

under the age of 16 were able to purchase *gutka* easily (National Centre for Transcultural Oral Health, 2001). Only a few areca products give specific health warnings on the dangers of chewing areca nut, although most carry the statutory health warning regarding added tobacco. In 20 commercially processed and packaged areca-nut products on sale in the the United Kingdom, only three carried a health warning related to oral cancer; none warned about submucous fibrosis or potential addiction (Trivedy, 2001).

(*d*) *Limited bans in other countries*

In the late 1970s, the Public Services of Papua New Guinea issued a ban on betel-quid chewing in government offices (Burton-Bradley, 1978). Possession of areca nut in the California public school system is grounds for suspension (Croucher & Islam, 2002). In Singapore, spitting in public places can lead to a fine, indirectly discouraging the practice of betel-quid and areca-nut chewing (Cheong, 1984).