Ethnotaxonomy of breadfruit cultivars in Samoa[1]

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Introduction

Pacific islanders have developed an elaborate system of folk taxonomy used to distinguish between and assign names to different breadfruit cultivars. Distinctions are based on fruit shape, flesh color, presence of seeds, cooking or storage qualities of the fruit, leaf shape, and horticultural requirements (Ragone, 1995, 1997)[2]. Names, and in some cases, descriptions, of up to 30 varieties have been recorded. (Wilkes, 1845; Setchell, 1924; Buck, 1930; Christophersen, 1935; Parham, 1966; and Ragone, 1991, 1997)[3]. The purpose of our study was to determine how many breadfruit cultivars there are in Samoa and how they are named.

Methods

Interview Techniques - In July 2000, 354 Samoans living in Samoa and American Samoa were interviewed about their knowledge of breadfruit types. Villages or towns chosen for the study were Saipipi and Falealupo on Savai'i, and Apia (the capital city) in the independent state of Samoa; and Olosega and Ofu of the Manu'a Group, Pago Pago (the capital city) and Afono on Tutuila Island in American Samoa. Cultural experts in the villages of Tafua and Falealupo, Savai'i, were also interviewed. The interviews were done in the Samoan language by two-person teams and the responses were recorded on a standard form. Interviews were conducted in homes and other areas of work and transit in the town areas. The age, date and place of birth, gender, occupation, place of residence, and marital status of each person interviewed were recorded. Each Samoan was asked to name as many different types of breadfruit as they could, together with information about local availability of each type, and whether or not each type had seeds. The names were then read back to the interviewee to ensure their accuracy, and they were asked if they could think of any more names.

One group interview with 43 Samoan chiefs was conducted during a chief's council meeting after a kava ceremony in Falealupo village. Some of the Samoans, particularly those deemed to be cultural experts (see below), were interviewed at length to elicit detailed information about uses, cultivation practices, descriptions, and naming rules or patterns of rules used to name breadfruit cultivars. Videotapes and/or audio recordings of these interviews were made. Herbarium vouchers of different breadfruit types were made and deposited in the herbarium of the National Tropical Botanical Garden (PTBG).

Recording of data; definitions of idiosyncratic and expert respondents - Interview data were entered into a spreadsheet on a portable computer in the field and grouped according to village. A saliency table of breadfruit types (Table 1) was prepared by ranking the breadfruit varieties recorded in the interviews by order of frequency of mention. If there was variation in the binomial or monomial form of a breadfruit variety we chose the form used by the majority of the respondents. Where there were slight differences in spellings or pronunciations, we adopted a standardized spelling/pronunciation used by the majority of the respondents, e.g., 'ulu ea and 'ulu uea were scored together as 'ulu ea for statistical purposes.

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Before analyzing the data, we sought (1) to remove idiosyncratic responses and interviews, and (2) to identify and highlight expert respondents. We regarded any breadfruit name asidiosyncratic if it was mentioned by only one informant, unless that informant was an expert as defined below. We also defined as idiosyncratic any informant who mentioned two or more idiosyncratic taxa during their interview. Idiosyncratic names and interviews were excluded from our statistical analyses. We identified and defined as an expert any individual (1) who reported a number of breadfruit cultivars equal to or greater than one standard deviation above the mean numbers of names reported by all informants; and (2) whose reported names included 90% of those cultivars that were known by at least half of all respondents.

Each breadfruit name in the saliency table was scored as an ambiguous monomial (AM), unambiguous monomial (UM), ambiguous binomial (AB), or unambiguous binomial (UB). This was accomplished by comparing the name to two comprehensive dictionaries of the Samoan language published by Milner (1966)[4] and Pratt (1861)[5] and checking the terms with two bilingual speakers of English and Samoan. A term was regarded as ambiguous if it conceivably could refer to another object other than breadfruit.

Results

Interviews - We found that breadfruit names in Samoa invariably consist of a binomial composed of a generic level term 'ulu modified by a specific epithet (Table 2), or a monomial in which only the specific level epithet is used and the generic level term is understood. Monomials can also sometimes be expressed as several words that form a coherent specific epithet. In a sense, however, all breadfruit varietal names in Samoa are binomials, since when only the specific epithet is used, the generic term 'ulu is understood. This understanding was made explicit to us by many informants, who, if questioned intensely or if they thought we were naïve, would add the generic level term 'ulu to the description to emphasize that they were indeed referring to a type of breadfruit. All persons interviewed used the generic level tem 'ulu for breadfruit, with the single exception of the village of Tafua, Savai'i where out of deference for the paramount chief "Ulu Taufa'asisina, the respect word for breadfruit, fa'atau, is always substituted for the term 'ulu.

Table 1. Saliency of Samoan breadfruit cultivar names

Name	Respondents		%	Rank	Binomial/ Monomial	Translation
ma'afala	(308)	315	90	1	UM	_
ulu ma'afala	(7)					
puou	(283)	286	81	2	UM	_
ulu puou	(3)					
aveloloa		238	68	3	UM	_
maopo	(214)	218	62	4	UM	_
ulu maopo	(4)					
ulu ma'a		195	56	5	AB	solid(iii)
ulu ea	(185)	194	55	6	AB	Uvea Island
ulu uea	(9)					
ulu manu'a		131	37	7	AB	Manu`a Islands(iv)
momolega		116	33	8	UM	_
ulu sina	(79)	80	22	9	AB	white(i)
ulu asina	(1)					
sagosago	(55)	59	17	10	UM	_

ulu sagosago	(4)					
peti	(42)	56	16	11	AM	fat(i)
ulu peti	(14)					
ulu tala	(51)	54	15	12	AB	spiny(i)
ulu talatala	(3)					
fia puou	(34)	38	11	13	UM	like a puou(ii)
ulu fia puou	(1)					like a puou(ii)
fa'a fia puou	(3)					like a puou(ii)
ulu fefelo	(22)	33	9	14	UB	_
fefelo	(11)					
ulu initia		29	8	15	AB	India breadfruit(iv)
ulu fau		26	7	16	AB	fibrous(iii)
mase'e	(21)	23	7	17	UM	_
ulu mase'e	(2)					
ulu se'e		19	5	18	AB	sliding(iii)
ulu kiripati/kilipati		11	3	19.5	AB	Gilbert Islands(iv)
gutufagu	(9)	11	3	19.5	UM	neck of the bottle(i)
ulu gutufagu	(2)					
puou fatu		10	3	21	UM	seedy puou(ii)
ulu falaoa		8	2	22	AB	bread loaf(i)
vasivasi	(5)	6	1	23	UM	_
ulu vasivasi	(1)					
puou tala		5	1	24	UM	spiny puou
ulu fiti		4	1	26	AB	Fiji(iv)
tui tu		4	1	26	AM	spiny(iv)
fia maopo		4	1	26	UM	like a maopo(ii)
puou maopo		3	1	28.5	UM	looks like a maopo(ii)
maualuga		3	1	28.5	AM	high(v)
ulu faga		2	1	31	AM	eel trap[1] or bay
malali		2	1	31	AM	smooth(i)
matatelele	(1)	2	1	31	AM	big eye(i)
ulu matatelele	(1)					
ma'afala tala/talatala		1	1	33	UM	spiny(i)
puou tutunu		1	0	33	UM	roasting(iii)
ulu toso		1	0	33	AB	pull(vi)
ulu to'elau		1	0	33	AB	Tokelau Islands(iv)
ulu tau		1	0	33	AB	pluck(vi)
ulu sasalapa		1	0	33	AB	Custard Apple(i)
puou fefelo		1	0	33	AM	puou like a fefelo(ii)
ulu fagaloa		1	0	33	AB	Fagaloa village(iv)
avesasa'a		1	0	33	UM	_
ulu pase'e		1	0	33	AB	lazy(ii)
ulu mama		1	0	33	AB	light weight(i)
segatoa		1	0	33	UM	_
po'eloa		1	0	33	UM	_
fia ta		1	0	33	AM	wants to be slashed(vi)

(i) appearance, (ii) comparative, (iii) culinary, (iv) geographical, (v) descriptive action, (vi) respect term

There are several different categories of breadfruit names (See Table 1). One type of name reflects the appearance of the breadfruit, such as "ulu sina" or "white breadfruit," while other names are geographical, reflecting the putative origin of the variety such as in "ulu manu'a" or "Manuan breadfruit." Another type of breadfruit name reflects its culinary properties as in

"ulu ma'a" or "hard breadfruit." Some breadfruit names are comparative in the sense that they reflect overall similarities to another variety such as in "fia puou" - " wants to be like a puou. Many breadfruit names, such as puou, are irreducible in the sense that they either cannot be translated or their meaning has been forgotten by contemporary Samoans.

Table 2. Examples of Samoan breadfruit monomials and binomials

Generic term		Specific modifier
Binomial	'Ulu	sina
Monomial	Ø	ma'opo
Monomial with two words in specific epithet	Ø	fia ma'opo
Binomial with honorific	Fa'atau	ma'a

Ø - generic term is understood

Recording of data; definitions of idiosyncratic and expert respondents - Using the redacted data set (determined b excluding idiosyncratic names and four informants) and by combining monomial/binomial variants (using a majority rule) and cognates, we recorded a total of 46 different names for breadfruit varieties during individual interviews with 350 Samoans. The redacted data set excluded four interviews that were determined to be idiosyncratic yielding a "Babble Statistic" or B.S. level of 1% for the entire data set. The effect of excluding these four interviews (Table 3) had only a small effect in the mean number of taxa reported (6.3 redacted, 6.4 unredacted) and no effect on the median number reported (6), with the number of breadfruit varieties reported ranging from 0 to 20.

We found that 63 of the 354 individuals who were interviewed reported 10 or more names; which is one standard deviation above the mean number of names known by all informants. Three of these individuals were excluded as experts because they did not meet the second expert criterion: they did not know 90% of the cultivar names known by more than half of all informants. Therefore, 60 individuals were identified as cultural experts.

Table 3. Summary statistics: Number of breadfruit names known by Samoans.

	All respondents/ all names	Final respondents/ final names	Experts/ final names
Mean	6.4	6.3	11.5
Median	6.0	6.0	10.5
Minimum	0.0	0.0	10.0
Maximum	20.0	20.0	20.0
Respondents	354.0	350.0	60.0

Since a histogram of all data indicated that the data were not normally distributed and since the data do not come from random samples, we decided to use non-parametric statistics in our analysis.

Binomiality, Saliency, and Linguistic Ambiguity:- Using the redacted data set, i.e. the entire data set less idiosyncratic interviews, we sought to study the possible relationship between the saliency of breadfruit names and their binomiality. The saliency table - constructed by ranking the breadfruit names in order of

frequency of mention - was analyzed for prominence of binomial versus monomial ethnotaxa to see if monomials were used to describe more salient varieties. To determine if binomial taxa are less salient than monomial taxa we tested

H^o = there is no relationship between binomiality and saliency

H^1= there is a relationship between binomiality and saliency

Using a Wilcoxon rank sum test (Remington and Schork 1970, Snedecor and Cockran, 1989) and testing at the 0.05 level for significance. Ties were scored by using the average of the ranks of tied numbers. The test statistic ($z = -0.83$) was not significant at the 0.05 level so Hypothesis H^1 was rejected: there is no relationship between binomiality and saliency. To limit influence of infrequent names, the two hypotheses were again tested with the Wilcoxon Rank-Sum using only the 66% most salient taxa. In this second test, H^1 was again rejected ($z = 0.74$). A third test, comparing only the top ten most salient names, was again performed, using a W statistic rather than Z because of the small sample size. In this third test, H^1 was rejected a third time, so we can unequivocally state that there is no significant relationship between saliency and binomiality in breadfruit names reported by 350 Samoans.

The hypotheses

H^o = there is no relationship between ambiguity and binomiality

H^1= there is a relationship between ambiguity and binomiality

were tested by constructing a 2 x 2 contingency table, with the columns representing monomial names and binomial names and the rows representing linguistically ambiguous and linguistically unambiguous names (Table 4). An O^2 statistic was calculated and tested at the 0.05 level for significance using Yates correction for continuity (Snedecor and Cochran, 1989)vi.

An O^2 statistic was calculated ($O^2 = 22.2$, $p<0.001$); and H^o was rejected. Binomiality is significantly related to linguistic ambiguity among our 350 informants. However when the saliency table is analyzed for a relationship between linguistic ambiguity and saliency, the relationship is even stronger: 82% of all breadfruit types are either unambiguous monomials (UM) or ambiguous binomials (AB); e.g., binomials where specific epithet alone, out of context, could conceivably refer to another object than breadfruit.

Table 4: 2 x 2 contingency table

	Binomial	Monomial	Totals
	Observed (Expected)		
Ambiguous	19(11.3)	7(14.7)	26
Unambiguous	1(8.7)	19(11.3)	20
Totals	20	26	56

Age, gender, westernization and cultural competency - We sought to determine if there is a relationship between the age of the respondent and number of breadfruit names reported by calculating the median number of taxa reported by respondents in each of nine age classes (Class 1 = ages 0-9; Class 2 = ages 10-19; etc.). These data were used to test these hypotheses

H^o = there is no relationship between age class and number of breadfruit names reported

H^1= there is a relationship between age class and number of breadfruit names reported

by calculating a Spearman's rank correlation coefficient and testing for significance at the 0.05 level.

Table 5: Knowledge of breadfruit names based on age class.

Age Class (Years)	Mean	Rank	Difference	D squared
1 (0-9)	1.40	9	-7.60	57.76
2 (10-19)	4.10	8	-3.90	15.21
3 (20-29)	6.10	7	-0.90	0.81
4 (30-39)	6.70	6	0.70	0.49
5 (40-49)	7.40	5	2.40	5.76
6 (50-59)	8.00	3	5.00	25.00
7 (60-69)	9.20	1	8.20	67.24
8 (70-79)	8.60	2	6.60	43.56
9 (80-89)	7.50	4	3.50	12.25
				sum 228.08
				r = -0.90

Since at 7 (n-2) degrees of freedom, the two-tailed significance level for the correlation coefficient r at the 0.01 probability is 0.798, H^o is rejected, showing a strong relationship between age class and mean number of breadfruit taxa reported.

We wished to determine if the location of one's residence had any influence on the number of breadfruit names that were known as well as whether gender played a role in such knowledge. Ordinarily an analysis of variance would be used to see if such differences were important. However, since our data are not randomly collected independent samples with normal distribution, and since sample variances were not equal for the sub-samples, such an ANOVA analysis with the parametric F statistic would be inappropriate. We therefore used the non-parametric Kruskal-Wallis test, which generates a statistic comparable to that of an ANOVA to test using the O^2distribution at the 0.05 level of significance for the following hypotheses

H^o = there is no difference between villages in the number of breadfruit names known

H^1 = villages differ in the number of breadfruit names known.

This test yielded an H statistic of 123.6. Since multiple ties occur in the data set, we corrected this statistic by dividing by the correction factor

$1 - '(T^3 - T) / N^3 - N = 0.99$

Where T is the number of ties for each observation and N is the sample size. Our corrected statistic H corr = 124.7. At seven degrees of freedom, since H exceeds 203, we are able to reject H^o at $p<0.005$, hence place of residence is highly significant in influencing number of breadfruit names known.

Table 6. Knowledge of breadfruit names based on place residence.

	Ofu	Olosega	Afono	Pago	Apia	Falealupo	Saipipi
Mean	5.1	5.3	5.5	5.0	5.6	7.5	8.7
Median	5.0	5.0	6.0	5.0	5.5	7.0	8.0
Minimum	0.0	0.0	0.0	0.0	1.0	1.0	0.0

Maximum	10.0	11.0	11.0	11.0	11.0	14.0	20.0
Respondents	51.0	52.0	28.0	59.0	34.0	33.0	88.0

We also tested for gender differences using the Kruskal-Wallis test. Our hypotheses were:

H^o = there is no difference between genders in the number of breadfruit names known

H^1 = men and women differ in the number of breadfruit names known.

For the total of 192 women and 158 men in our sample, the corrected H statistic was 21.7, allowing us to reject H^o at the $p<0.005$ level. Hence men know significantly more breadfruit names than women.

Table 7: Knowledge of breadfruit names based on gender

	All females	All males	Expert females	Expert males
Mean	5.6	7.1	10.9	11.9
Median	6	7	10	11
Minimum	0	0	10	10
Maximum	19	20	19	20
Respondents	192	158	23	37

Discussion

All of us were profoundly impressed by the diversity of breadfruit varieties -46- recognized by the Samoans in our sample. We are unaware of any major supermarket in the United States that stocks anything approaching this variety of crop diversity, which the Samoans grow in and about their villages. Our data set though, allows us to do more than to celebrate the richness of Samoan cultivar diversity. The expansiveness of our data set, with a redacted sample size of 350, allows us to rigorously test several hypotheses about folk taxonomy.

We have here adopted the five criteria of Brown (1985, pp. 44-45)vii in determining which Samoan breadfruit names are binomials or monomials: 1) one constituent of the label stands on its own, 2) one constituent is not a major life-form ("tree"), 3) morphologically dissimilar (i.e., sea horse is not a type of binomial), 4) shared generic constituent, and 5) composite terms "mate of", "like", "similar" are not binomials.

The suggestion that monomials should be used in folk taxonomy to label highly salient folk taxa has been repeatedly asserted for the simple reason that "binomial names for lower-salience referents are more easily remembered than unitary lexemes for those referents." Brown (1985, p. 52). In a key paper in the development of the theory of ethnotaxonomy, Brown argues that the relationship between saliency and monomiality should be increased in agricultural peoples: "as the size of a folk biology taxonomy increases with a shift to agriculture, the percentage of taxa labeled binomially is augmented as well... referents labeled by overt marking tend to be less salient...Since binomial labels are overt marking constructions, their referents (biological taxa) typically are of lower salience than biological classes labeled by unitary lexemes." (Brown 1985, p.50)

Such a common-sense result is not immediately intuitive to all observers. Terrence Hays has argued that "binomialization might be common in sets of taxa that are highly salient; i.e., domesticated plants or animals of which varieties or species (binomially labeled) would have

resulted from domestication...binomialization is likely to occur in distinguishing among closely related taxa, and that these are especially common with domesticated plants, where botanical diversity (along few or a single dimension has been fostered and then recognized with binomial expressions." (Brown 1985, in a note on p.52).

To this suggestion, Brown (1985, p.52) responded that from his literature sample, "54% of 163 cultivated plants have binomial labels versus 17% of the 551 non-cultivated ones... Binomially labeled domestic taxa dominated by the same generic class tend to be morphologically very similar, differing from one another only with respect to variables of one, two, or three dimensions at most...Another manifestation of lower salience would be binomialization of their labels."

What is needed to carefully test these competing hypotheses has been a direct indicator of saliency in a folk setting. We have here adopted frequency of mention is a standard interview as an index of saliency of a folk taxon. Using that standard, we were surprised to find no support for either Brown or Hays; there is no statistical association whatsoever between saliency and binomiality for names of Samoan breadfruit varieties. It could be argued that our restricted taxonomic focus (i.e., we here consider only breadfruit varieties), makes our study an inadequate analysis of the broader theory. However, we do note that by restricting ourselves to a single crop, "Intensity of Cultural Use" (Turner 1988) is held constant, so our data on comparative saliency are strictly comparable. Other studies on other crop varieties in other places would add considerable power to this basic approach.

Our data also found some partial support for the argument that there is often considerable disagreement among indigenous societies on folk names. Working with a different agricultural people in New Guinea, Stilltoe (1980:141) found that all Wola hold in common a set of cultivar names, but when forced to apply these names to actual plants, "they only agree about 50% of the time about which name goes with which plant. He surmised that disagreements over naming plants most likely occurs at this taxonomic level since such identifications frequently depend on fine details or morphological variations (Stilltoe, 1995).

Although we did note some slight differences in the use of monomial or full binomial terms (as might be expected when attempting to clarify a plant name for a foreign investigator), we found surprising little variation in plant names, once cognates with superficial differences were clumped together in the analysis. What surprised us further was not the differences in names, but the overall consensus in names which were recorded on islands over 400 km apart. The number of idiosyncratic responses, such as those invented on the spot to please a persistent investigator, was very low. Less than 1% of our interviews were excluded from analysis because of idiosyncrasy. However, in all settings, we did find two broadly different realms of ethnobotanical knowledge: common knowledge and expert knowledge.

A key outcome of our study was being able to quantify what makes an individual an expert. Future ethnobotanical fieldwork in Samoa will be greatly facilitated by the fact that we have identified a large group of experts who we can work with and conduct in-depth interviews about breadfruit and other cultural practices. For example, we will work extensively with some of these experts to ascertain the conservation status of breadfruit varieties in Samoa, especially those that were only known by one or a few individuals. We surmise that varieties such as ma'afala and puou, known by 90 percent and 81 percent, respectively, of the Samoans we interviewed are common in cultivation and therefore conserved in situ, whereas the more uncommon varieties may be at risk and require conservation strategies. This method can also

benefit students and researchers conducting ethnobotanical projects elsewhere. It is possible in a fairly short time to interview a large number of people about a specific topic and from that group quickly and accurately identify those who possess expert knowledge. Working primarily with expert individuals is a useful, and timely, strategy to maximize obtaining reliable, specialized, and verifiable information. In our sample, 17 of the experts were in their 60s, and six were 71 years old or older; several of these were in very poor health. It is critical that the traditional cultural knowledge of these elderly experts be documented before it is lost.

We found that place of residency has a strong impact on the amount of knowledge about breadfruit names that an individual possesses. As might be expected, the traditional villages of Saipipi and Falealupo on the remote island of Savai'i score highest in breadfruit knowledge. We were surprised, however, that Ofu and Olosega villages in the remote Manu'a archipelago of American Samoan scored at about the same rate as the residents of the capital cities of Pago Pago (American Samoa) and Apia (Independent Samoa). This may be due to the prevalence of sending high school age youths off-island for education, where they are removed from participating in daily cultural activities and hence do not have the opportunity to learn traditional knowledge and practices from their elders.

There is, in effect, a brain drain as adults leave the Manu'a islands for Tutuila, Hawaii, or the U.S. mainland. For example, many families maintain residences both in Ofu or Olosega and on the island of Tutuila. Adults in their 30s to 50s are working in the wage economy on Tutuila, providing a home for their high-school-attending children, or caring for their elderly parents in their 60s to 80s who have moved to Pago Pago for medical care and long-term convalescence. The mayor of Olosega posited that since the residents of Ofu and Olosega rely primarily on earned income and family remittances rather than subsistence agriculture, there is little need to keep such breadfruit knowledge alive. In any case, it appears that ethnotaxonomic knowledge is exceedingly fragile, and can quickly disappear, even from apparently remote areas.

Gender differences in breadfruit knowledge reflect gender-based divisions of labor inherent in Samoan society. Men are more likely to work in the plantations, plant and harvest breadfruit, and prepare them in the umu or stone ovens. It is important to note, though, these gender differences, while reflected in the mean and median number of names known by men and women do not reflect expert knowledge. The second most knowledgeable person we met in Samoa was a woman. In the group of 60 individuals we identified as having expert knowledge, 23 were women and 37 were men.

This suggests that villagers who possess strong ethnotaxonomic knowledge should be recruited to oversee conservation and agro-biodiversity programs in Samoa and elsewhere. It is critical that indigenous knowledge about crop diversity guide conservation and agricultural development projects to ensure that traditional varieties, cultivation practices, and cultural practices and knowledge are preserved rather than eroded.

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[1] Adapted from original research by Namulau'ulu G. Tavana Ph.D., Paul Cox Ph.D., Diane Ragone Ph.D., Patricia Stewart D.O., Rebecca Stone, Paul M. Cox, and Joan Stevens of the Institute for Ethnobotany.

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