The Basis of Indigenous Knowledge of Tree Fodder Quality and its Implications for Improving the Use of Tree Fodder in Developing Countries.

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Abstract

Many interventions generated by research with the aim of improving the nutritional status of livestock in developing countries have failed to realize their apparent potential when implemented on farms. It is now widely accepted that this is because farmers try to meet a wide range of objectives in feeding their animals. Their decision making can be supported by a sophisticated, indigenous knowledge. When researcher-developed technologies fail to account for this, they may be deemed unacceptable by the farmer. This paper explores one example of an indigenous knowledge system that relates to the quality of tree fodder used by farmers in Nepal. Our results suggest that the knowledge of tree fodder quality possessed by farmers is quite consistent with the level of information that may be generated from the laboratory analyses that are commonly used by nutritional researchers for the same purpose. Of the two distinct indigenous knowledge systems from Nepal used, one (*obanopan*) appeared to relate to digestibility of tree fodder (as predicted by an *in vitro* test) and the other (*posilopan*) that was perceived as an indicator of general nutritional quality may relate to the ability of a tree fodder to promote the supply of protein at the duodenum. However, the relationship between *obanopan* and *in vitro* digestibility indicated that Nepalese farmers, in preferring to use *obano* fodder, also preferred less digestible fodder due to its ability to fill animals in times of feed shortage. This observation - and the fact that recommendations derived from a panel of nutritionists viewing a set of laboratory indicators describing the tree fodder studied did not appear to account, in any way, for the *posilopan* criterion judged important by farmers - highlight the paramount importance of interpreting nutritional information against farmers objectives for a given set of circumstances. An initial analysis of complementarity between the information provided by farmers' perceptions of fodder quality and those generated in a laboratory would appear encouraging for a more integrated approach to assessing fodder quality for the smallholder farmer.

Keywords

nutritive value, fodder quality, indigenous knowledge, *obano*, *posilo*, tree fodder

Introduction

The impact of research-generated interventions for improving the availability and use of feeds on resource poor farms in developing countries has been patchy. Technologies which, in controlled trials, may enhance animal performance have repeatedly failed to find favour off the research station. Traditionally, researchers have tended to attribute their lack of success to ignorance and inertia amongst farmers. Relatively recently, it has become more widely appreciated that farmers need to balance a complex array of conflicting, multiple objectives and may have access to a sophisticated knowledge base of their own that helps them to achieve this. Furthermore, constraints that influence adoption are usually seasonal, they may arise in a part of the farming system that lies beyond the scope of the controlled trial and they can be both biological and socio-economic in nature. Under these circumstances, a trial result that demonstrates a short-term improvement in milk yield or growth rate has little bearing, for the intended end-user, on the acceptability of the management option that produced it.

Much has been made in the anthropological literature of the potential utility of an approach to technology derivation and testing that is based on the integration of indigenous and scientific knowledge; see Sillitoe (1998) for a recent synthesis. Of particular significance for improved technology adoption is the contention that indigenous knowledge, which is necessarily inclusive of farmers' objectives, may be used to focus scientific descriptions of biological processes more sharply on farmers' problems to avoid the difficulties described above. However, approaches for the systematic interpretation of indigenous knowledge that must precede its integration with biological knowledge have not yet been forthcoming.

In this paper, we describe an initial attempt to derive such a biological interpretation of an indigenous knowledge system, relating to tree fodder quality, that is operated by Nepalese smallholder farmers. The implications of this interpretation for the delivery of nutritional support to these farmers are considered and potential complementarity between indigenous and laboratory-based indicators of tree fodder quality is explored.

Resource-poor farmers in Nepal have a detailed indigenous knowledge system for describing the nutritive value of tree fodder used as supplements for ruminant livestock (Rusten and Gold, 1991; Thapa *et al*., 1997). Tree fodder is particularly important as a green, nitrogen supplement to poor quality crop residues during the dry season (November to June) when feeds are scarce (Panday, 1982). This fodder may be collected from forest areas or, increasingly, from trees grown on farmland, including the banks of crop-terraces (Carter and Gilmour, 1989). A previous investigation of farmers' knowledge (Thapa *et al*., 1997) has examined, in detail, two local classification systems for tree fodder; *posilopan* and *obanopan.*

The Nepali term *posilo* may be literally translated as "nutritious". *Posilo* fodder is said, by farmers, to promote milk and butter fat production in lactating animals, rapid live weight gain and animal health. They are also palatable and satisfy appetite (Thapa *et al.*, 1997). *Obano* fodder is also valued by famers and the term may be translated as "dry and warm". Rusten and Gold (1991) suggest that the term refers to the consistency of dung produced. However, farmers also state that *obano* fodder "fills the animal", is highly palatable, particularly during colder months, and is eaten voraciously, although causing constipation if fed in excess. The two classification systems are, generally, applied consistently amongst farmers and, moreover, are demonstrably independent of each other (Thapa *et al.*, 1997; Walker *et al.*, in review).

Materials and Methods

The data and fodder samples used in the study reported here were collected on farms in Solma Village Development Committee Area, Terathum District, situated in the middle hills of eastern Nepal.

Over 90 species, subspecies and landraces of trees, shrubs and bamboos provide farmers in Solma with fodder (Thapa *et al*., 1997). Eight of these were selected for study. These represented five species (*Albizia julibrissin*, *Ficus nemoralis*, *Ficus roxburghii*, *Ficus semicordata* and *Prunus cerasoides*), two botanically-differentiated subspecies of *F. semicordata* (var. *Montana* and var. *Semicordata*) and two landraces of *F. nemoralis* (*sano pate dudhilo* [SPD] and *thulo pate dudhilo* [TPD]) and of *F. roxburghii* (*chillo pate nebharo* [CPN] and *khasre pate nebharo* [KPN]).

Procedures for ranking fodder according to the indigenous criteria applied by farmers (*obanopan* and *posilopan*), for the selection and sampling of individual trees and for the laboratory analyses conducted have been described by Walker *et al.* (in review). Farmers' rankings of the eight fodder types for their *obano* and *posilo* status (Walker *et al.*, in review) are presented in Table 1.

A set of correlation analyses was carried out in order to:

- interpret the *obanopan* and *posilopan* criteria - on which farmers' assessments of fodder quality are based - in terms of the nutritional indicators used by scientists for the same purpose;
- consider the extent to which the perceptions of nutritive value that nutritionists derive from laboratory analyses are adequate for supporting improvements in the use of feed resources in developing countries. This analysis was based on a set of rankings of the relative quality of the different types of tree fodder generated by a group of expert nutritionists presented with a nutritional profile summarising the laboratory parameters.

Correlations of Obanopan *and* Posilopan *Rankings with Individual Laboratory Indicators*

Spearman rank correlation coefficients (R_S) and their levels of significance were determined for each of individual laboratory parameters on farmers' rankings for *obano* and *posilo* status.

Correlations of Obanopan *and* Posilopan *Rankings with Derived Laboratory Indicators*

With the exception of the *in vitro* estimates of digestibility, the laboratory parameters used to describe the tree fodder samples would not, taken individually, support a general assessment of nutritive value that could be regarded as relevant to the farmer. Thus, used on their own, these parameters are unlikely to be adequate for interpreting farmers' *obano* and *posilo* criteria. Farmers' perceptions of *obano* and *posilo* status have, like much indigenous technical knowledge, been derived empirically - from observing the outcomes of feeding different combinations of tree fodder. As such, they may be expected to represent a more aggregated view of fodder quality than any single, laboratory parameter. In Nepal, as in many tropical and sub-tropical countries, the principal use of tree fodder lies in supplementing low-protein diets based on crop residues. This suggests that at least one of the farmers' criteria for fodder quality assessment should relate to an ability to improve supplies of protein to the animal. In order to test this hypothesis, a set of protein supply indices (Table 2), each of which might be expected to correlate with duodenal protein supplies, were derived from individual laboratory parameters for each fodder sample. R_S were determined for each of these protein supply indices on farmers' rankings for *obano* and *posilo* status.

Assessments of Tree Fodder Quality by Nutritionists

The knowledge of tree fodder quality encapsulated in the *obanopan* and *posilopan* criteria represents a general assessment of the relative suitability of different types of tree fodder for meeting farmers' objectives in feeding them to livestock. To produce a similar, general perspective of fodder quality based on the laboratory assessments, the data presented in Table 3 were shown, individually, to a group of 38 scientists with qualifications in applied animal nutrition. Each fodder was identified only by a single, letter code. Participants were asked to use the nutritional profile to rank - from 1 = best to 8 = worst - the eight fodder types for their likely ability to supplement straw-fed, lactating cows, kept under small-holder conditions, in order to improve milk production. For consistency with the farmers' rankings ties were disallowed, R_S was determined for the nutritionists' rankings, both individually and aggregated, on farmers' rankings for *obano* and *posilo* status.

Complementarity Between Indigenous Technical Knowledge and Laboratory Assessment

The interpretation of one knowledge system in terms of another – in this case farmers' empirical knowledge of tree fodder quality in terms of chemical parameters determined in a laboratory - raises the possibility that a degree of complementarity may exist between them. Ultimately, the identification and exploitation of any such complementarity between two knowledge systems may be regarded as an opportunity to strengthen both of them. In the current case, using this complementarity has clear attractions for improving the efficiency of information use and in ensuring consistency in fodder evaluation. To evaluate potential complementarity between farmers' and laboratory criteria for assessing fodder quality, differences in the abilities of correlated variables within each of the systems to distinguish between individual pairs of tree fodder types were examined.

All correlation analyses and the estimation of standard errors of means (SE_M) were conducted using the standard procedures provided by Genstat 5, release 3.2 (NAG, 1995).

Results

Nutritional profiles for the eight types of tree fodder, derived from the laboratory analyses carried out, are shown in Table 3.

Correlation Analyses

The results of correlating ranks based on individual laboratory indicators of nutritive value with farmers' rankings for *obano* and *posilo* status are presented in Table 4. Farmers' rankings for *posilo* status did not correlate significantly with any of the rankings by laboratory parameters. *Obano* status was significantly correlated ($P < 0.05$) with the volume of gas produced after a 72h *in vitro* fermentation in rumen fluid using the method of Theodorou *et al.* (1994) and the overall loss of DM during this fermentation. The positive value of R_S for both of these relationships indicated that *obano* fodder, although highly valued by farmers, may be expected to be relatively undegradable in the rumen.

Table 5 summarises values of R_S for the correlation analyses of *posilo* status on the derived protein supply indices. Values of R_S for the simple indices (PSI-1 and PSI-2) based on the aggregated effects of crude protein content and estimates of degradability or digestibility *in vitro* were not significant. However, the introduction of the term representing recalcitrant condensed tannins in PSI-3 and PSI-4 resulted in significant correlation with *posilo* status at the 5% level of significance. PSI-1 was significantly correlated with PSI-2 ($P < 0.001$) and PSI-3 was significantly correlated with PSI-4 ($P < 0.001$) suggesting a high level of inter-correlation between predictions based on *in vitro* degradability in the gas production system and on the neutral cellulase technique.

The mean ranks, based on the nutritional profile presented in Table 3, of the group of nutritionists for the relative nutritive values of the eight types of tree fodder and their standard errors are presented in Table 6. The value of R_S for the aggregated correlation of these ranks on farmers' ranks for *posilo* status was not significant but the R_S of -0.87 for the correlation with *obano* status was ($P < 0.05$).

Complementarity Between Farmers' Rankings and Relative Nutritive Value Assessed by Laboratory Paramters

Examples of complementarity between rankings based on the two classification systems used by farmers and laboratory parameters correlated with these are shown in Figure 2. Farmers were able to discriminate tree fodder types effectively using the *obanopan* classification system for all pairwise comparisons with the exception of that between *Ficus nemoralis* [SPD] and *F. nemoralis* [TPD]. However, this pair could be distinguished by the *in vitro* neutral cellulase digestibility technique (NCD; De Boever *et al.,* 1988). Conversely, NCD was not as effective as *obanopan* in discriminating the sub-species of *F. semicordata* and the landraces of *F. roxburghii*. *Albizia* julibrissin and *Prunus cerasoides* were effectively distinguished from each other and from the *Ficus* species by both NCD and *obanopan* rankings. A similar degree of complementarity was observed between assessments based on PSI-3 and the *posilopan* classification system. Again the two landraces of *F. nemoralis* appeared to be more effectively discriminated by the laboratory methods than by rankings for *posilopan*, whilst sub-species and landraces of the other *Ficus* species were more effectively discriminated by the farmers' rankings. *A. julibrissin* and *P. cerasoides* were also effectively discriminated by both systems. *F. nemoralis* [TPD] and *F. semicordata* var. *montana* did not appear to be effectively discriminated from each other by either system.

Discussion

The lack of apparent associations between simple chemical parameters and *obanopan* and *posilopan* is to be expected. Farmers' fodder evaluation criteria are based on a great deal of empirical observation of the outcomes of different strategies for using tree fodder. These have been assessed, directly, in terms of their ability to meet production objectives. Therefore, whilst it may be possible to question the bases on which these criteria are applied, farmers' perceptions of the value, for their purposes, of *obano* and *posilo* fodder would appear to be indisputable. Conversely, variation in the individual chemical constituents of feeds is likely to have a marked impact on nutritive value. However, the implications of such variation for production objectives can only be established when it is interpreted against interactions with other chemical indicators of nutritive value. Thus, programmes of laboratory analysis used to support the improved utilisation of feed resources in developing countries should include indicators, such as measures of *in vitro* digestibility, that have a clearly defined, aggregated impact on animal performance or use mechanistic models that integrate the effects of variation in individual chemical parameters and their interactions.

This principle is supported by the association observed between *obanopan* and *in vitro* degradability in the gas production system that would appear to confirm an underlying biological interpretation for *obanopan*. A more detailed analysis, beyond the simple correlations presented here, is clearly required to interpret fully the biology of *obanopan*. However, the importance of the observation that farmers' preference for *obano* tree fodder also represents a preference for a relatively poorly degradable supplement should not be underestimated. This finding is consistent with farmers' observations that *obano* fodder "fills the animal" (Thapa *et al.*, 1997). The study reported by Rusten and Gold (1991), also conducted in the Nepal Himalaya, confirms this characteristic of *obano* fodder and a similar knowledge system has been observed in Himachal Pradesh (Louise Garde, *pers. comm.*). Indeed, a perception amongst farmers of this desirable attribute of tree fodder may be widespread. Roothaert *et al.* (1997) interviewing farmers in Embu, Kenya, reported that 48 *per cent* of respondents in an agro-ecological zone in which serious, seasonal restrictions to feed supplies are common, expressed a need for tree fodder which could induce "satisfaction of the animal".

There is a tendency amongst animal scientists to assume that the implications of variation in nutritive value indicators are fixed. Accordingly, a digestible diet is, generally, regarded as being of greater value than an indigestible diet. This is understandable as the development of the discipline has been driven, largely, by the relatively simple production systems of industrialised countries in which multiple production objectives are rare. However, it is evident that promoting "improved" feeding strategies based on such an assumption to farmers', who value *obano* fodder is unlikely to result in their widespread uptake. It is certainly tempting to conclude that the narrow adoption of technologies that increase the digestibility of crop residues may not be unrelated to some of the observations presented here. Thus whilst the laboratory techniques themselves may be of use, it is probably futile and unscientific to apply them in the absence of an interpretation of farmers' objectives.

This point is reinforced by the correlations between the nutritionists' and farmers' rankings of the eight types of tree fodder. The individual nutritionists' achieved a reasonable level of consistency in individual correlations with *obanopan* (Figure 1) reflecting the weight that they gave, in their assessments, to the parameters that related to *in vitro* degradablity. This, of course, resulted in nutritionists' quality rankings that were inverted when compared with those of the farmers' for *obano* quality. Furthermore, the nutritionists' ranking would not have been able to provide any indication of the *posilo* status that is deemed equally important by farmers.

It should be pointed out here that the task of ranking fodder in this way is probably one that few nutritionists have been asked to undertake. This was reflected in the relatively low response rate (19 out of 38) and the numerous qualifying statements returned with the rankings that were received. Those who were prepared to commit themselves to this uncomfortable task are to be applauded as the authors concluded that they themselves would probably have been amongst the non-responders. Nonetheless, this kind of ranking exercise reflects the nature of the questions most frequently asked of specialists by farmers and extension services; that is, "is fodder A better than fodder B". We can only conclude that, at present, we are not particularly well-equipped to meet this challenge.

None of the existing laboratory parameters tested offered a satisfactory interpretation of *posilopan*. As *obanopan* and *posilopan* are consistently applied by farmers (Walker *et al.*, in review) and appear, from our findings described here, to be applied independently, this suggest that there is a significant gap in our ability to evaluate tree fodder quality in the laboratory. The PSIs used in our interpretation of *posilopan* have not been validated. However they do suggest that, as might be inferred from farmers' descriptions of the characteristics of *posilo* fodder and its role in their production system, that this criterion is associated with the ability to improve the supply of protein at the duodenum. To be effective in predicting the impacts of tree fodder on duodenal protein supplies, a laboratory technique would need to embrace both ruminal and post-ruminal effects and should not exclude or be disrupted by the effects of tannins.

Our observation suggests that there is significant complementarity between farmers' assessments of tree fodder feeding values and relative assessments derived from laboratory information. Careful use of selected laboratory assessments of fodder not consistently distinguished by farmers in terms of its quality and effective reporting of the results to farmers could enhance the knowledge farmers apply in making routine feed management decisions.

The analysis suggested that, for both the *obano* - *chiso* and *posilo* - *kam posilo* status of the two sub - types of *F. nemoralis*, laboratory indicators might be used to augment the discriminatory powers of the farmers' classification systems. It might be argued that, under normal circumstances, there would be little practical utility in being able to discriminate *F. nemoralis* (SPD) more effectively from *F. nemoralis* (TPD) as the farmers using them clearly perceive no difference in their effects on animal performance. However, changing circumstances, in the availability and use of basal feeds for example, might require changes in approaches to using tree fodder such as that from *F. nemoralis* which would result in their compositional differences being expressed in differences in animal performance.

Relatively firm discrimination of the sub-types of *F. semicordata* and sub-types of *F. roxburghii* by the two classification systems and the lack of effective discrimination of differences between the fodder types by the use of NCD are clearly illustrated in Figure 2. Thus, although NCD correlated well with *obano* - *chiso*, it would appear that not all the variation perceived by farmers in the *obano* quality of the tree fodder studied can be explained in terms of a digestibility effect. However, we would argue that the approach described does have potential for supporting farmers in the development of improved feeding systems and strategies relying on the use of tree fodder, such as the better use of feed mixtures, selecting fodder trees of improved nutritive value. The ability for researchers and extension services to rank new species in a way that may be expected to be consistent with farmers rankings, and would relate to the quality of species that farmers already have experience of, would greatly assist in selecting fodder types that are most suited to their requirements. Laboratory techniques may also prove valuable in investigating the potential for genetic improvement of indigenous species and selecting superior types.

In conclusion, we believe that this work has broad implications for research aimed at the development of feeding strategies for developing countries that confer a genuine improvement as judged by their ability to satisfy farmers' objectives. For example, it is neither feasible or useful to collect, routinely, data on the chemical composition of tree fodder because of the range of trees used by farmers and the extent to which their nutritive value varies as a result of seasonal and other environmental factors. Farmers' knowledge encompasses the whole range of fodder types and environmental effects and the objectives of feeding strategies are implicit in their perceptions of the relative value of different fodder. Provided that a sound biological interpretation of farmers' knowledge systems is available - and the study presented here represents only an initial attempt to achieve this - it should be possible to integrate this knowledge with more mechanistic descriptions of nutrient utilisation in livestock (Thorne *et al*, 1997). Such an approach could provide the predictive systems that we require to promote more effective utilisation of tree fodder on farms. Conversely, some of the laboratory methods used in this study are also used routinely by breeding programmes in the assessment of new species or lines for fodder quality. A more detailed knowledge of the biological basis of farmers' knowledge will allow us to focus these evaluations more effectively on their objectives and to deliver results to them in terms that they can understand.

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Table 1: *Mean ranks and their standard errors for the* obano *and* posilo *status of fodder from the eight tree types (Walker* et al.*, in review).*

Tree (species, sub-species or landrace)	Mean rank (number of observations = 60)	SE_M	
***Obano* status**			
Albizia julibrissin	1.37	0.14	Most *obano*
Ficus semicordata var. *semicordata*	2.20	0.09	
Ficus semicordata var. *montana*	3.12	0.10	
Prunus cerasoides	3.70	0.17	
Ficus roxburghii [KPN]	6.06	0.15	
Ficus nemoralis [TPD]	6.23	0.36	
Ficus nemoralis [SPD]	6.42	0.18	
Ficus roxburghii [CPN]	6.85	0.17	Least *obano*
***Posilo* status**			
Albizia julibrissin	2.40	0.25	Most *posilo*
Ficus semicordata var. *montana*	3.07	0.25	
Ficus roxburghii [CPN]	3.57	0.15	
Ficus nemoralis [TPD]	3.83	0.23	
Ficus nemoralis [SPD]	4.10	0.20	
Ficus roxburghii [KPN]	4.65	0.18	
Ficus semicordata var. *semicordata*	6.40	0.18	
Prunus cerasoides	7.95	0.04	Least *posilo*

Table 2: *Derivation of the protein supply indices used to test the dependence of farmers' fodder quality assessment criteria on the ability to supply protein to animals fed low-protein basal diets*.

Index	Derivation
Protein supply index 1 (PSI-1)	CP x DMD_{70}
Protein supply index 2 (PSI-2)	CP x NCD
Protein supply index 3 (PSI-3)	CP / mean[CP] + DMD_{70} / mean[DMD_{70}] + CT / mean[CT]
Protein supply index 4 (PSI-4)	CP / mean[CP] + NCD / mean[NCD] + CT / mean[CT]

where DMD_{70} = dry matter digestibility after 70 hours incubation in an *in vitro* gas production system (Theodorou *et al.*, 1994); CP = crude protein; NCD = neutral cellulase digestibility (De Boever *et al.*, 1988); CT = non-extractable condensed tannin (Porter *et al.*, 1986).

Table 3: *Nutritional profiles of fodder from the eight tree types.* (This table, with single letter codes substituted for the tree names, was presented to the group of nutritionists for ranking purposes).

Laboratory parameter (g / kg DM unless otherwise stated)	Tree (species, sub-species or landrace)							
	Ficus roxburghii [CPN]	*Ficus semicordata* var. *montana*	*Ficus roxburghii* [KPN]	*Prunus cerasoides*	*Ficus semicordata* var. *semicordata*	*Albizzia julibrissin*	*Ficus nemoralis* [SPD]	*Ficus nemoralis* [TPD]
Dry matter	307	457	313	444	416	314	323	324
Crude protein	151	112	141	132	125	261	138	133
Acid detergent fibre	406	428	404	324	415	525	396	397
Neutral detergent fibre	584	566	570	543	565	753	586	590
Lignin	111	125	108	143	116	279	115	125
Acid detergent insoluble nitrogen (g / kg total N)	75	65	77	74	72	126	67	65
Total phenols (g gallic acid eq / kg)	2.0	3.0	2.3	2.7	2.7	1.4	1.7	1.5
Non-extractable condensed tannin (arbitrary units)	287	156	315	624	203	141	472	297
Neutral cellulase digestibility	581	526	566	502	543	354	700	720
Gas produced during 72h *in vitro* fermentation (ml)	142	102	129	107	101	118	174	187
DM loss after 72h in vitro fermentation (g / kg substrate)	443	372	406	404	351	303	540	547

Table 4: *Rank correlations of individual laboratory assessment parameters on* obano *and* posilo *status*.

Laboratory parameter	Rank correlation coefficient (R_S)	
(g / kg DM unless otherwise stated)	*obanopan*	*posilopan*
Dry matter	-0.64	-0.45
Crude protein	0.43	0.12
Acid detergent fibre	-0.52	0.40
Neutral detergent fibre	0.24	0.14
Lignin	-0.52	0.26
Acid detergent insoluble nitrogen (g / kg total N)	0.14	-0.12
Total phenols (g gallic acid eq / kg)	-0.38	-0.07
Non-extractable condensed tannin (arbitrary units)	0.50	-0.52
Neutral cellulase digestibility	0.79*	0.60
Gas produced during 72h *in vitro* fermentation (ml)	0.76*	0.40
DM loss after 72h in vitro fermentation (g / kg substrate)	0.81*	0.02

* **-** correlation significant at the 5% level.

Table 5: *Rank correlations of protein supply index (PSI) scores on* posilo *status*.

	Rank correlation coefficient (R_S)				
	Posilo status	PSI-1	PSI-2	PSI-3	PSI-4
Posilo status	1				
PSI-1	0.545	1			
PSI-2	0.490	0.974	1		
PSI-3	-0.806*	0.575	0.567	1	
PSI-4	-0.759*	0.446	0.463	0.984	1

Derivations of protein supply index scores are shown in Table 3.

* correlation significant at the 5% level.

Table 6: *Mean ranks and their standard errors for nutritive value of fodder from the eight tree types as assessed by expert nutritionists.*

Tree (species, sub-species or landrace)	Mean rank (number of observations = 21)	SE_M	
Ficus nemoralis [TPD]	1.71	0.27	Most nutritious
Ficus roxburghii [CPN]	3.14	0.28	
Ficus nemoralis [SPD]	3.24	0.45	
Ficus roxburghii [KPN]	4.10	0.21	
Prunus cerasoides	5.81	0.34	
Albizia julibrissin	5.86	0.58	
Ficus semicordata var. semicordata	5.90	0.34	
Ficus semicordata var. montana	6.24	0.32	Least nutritious

Figure 1: *Levels of significance for rank correlations (R_S) of individual nutritionists' rankings for nutritive value on farmers' rankings for* obano *and* posilo *status***.**

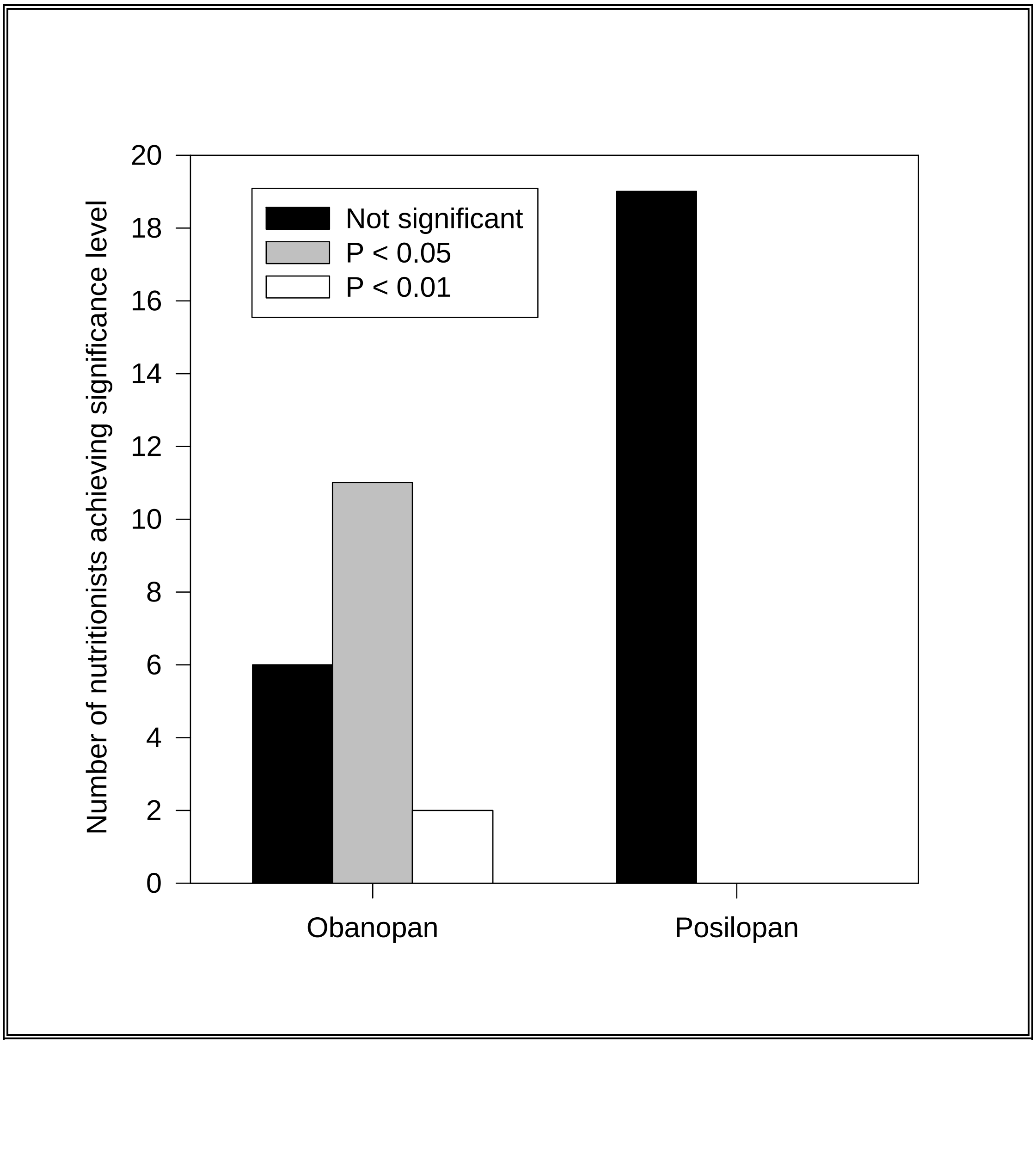

Figure 2: *Complementarity between farmers' rankings for* obano *and* posilo *status and corelated laboratory parameters.*