Dyeing Plants and Knowledge Transfer in the Yungas Communities of Northwest Argentina[1]

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Dyeing Plants and Knowledge Transfer in the Yungas Communities of Northwest Argentina. In the Yungas region of the Salta province, Argentina, interest in the use of plant dyes has revived due to new market demands and the growth of rural tourism. In this study we compare the use of dyeing plants recorded between 1994 and 2000 with those used in 2007 and 2008. We also address factors currently involved in the acquisition and transmission of knowledge. We worked with 39 randomly chosen participants (of which 11 were artisans) in the first stage, and 32 artisans in the second stage. Information was gathered during semi–structured interviews and structured questionnaires. Eleven and 57 dye plant species, and 10 and 2 mordants, were registered in the first and second stage, respectively. The use of soft plant parts has increased, relative to the employment of roots and barks. Pastels predominate among the colors obtained. Mothers are the main transmitters of this knowledge; however, new mechanisms of knowledge acquisition and transfer are gaining importance. These results provide an alternative for the diversification and quality of existing crafts.

Plantas tintóreas y transmisión del conocimiento en comunidades de Yungas del Noroeste Argentino. En las Yungas de la provincia de Salta, Argentina, ha resurgido el interés por el uso de tintes vegetales debido a nuevas demandas del mercado y al turismo rural. Se compara el uso de plantas tintóreas registrado entre 1994 y 2000 con las empleadas en el 2007 y 2008. Se analizan los factores que actualmente intervienen en la adquisición y transmisión del conocimiento. En una primera etapa se trabajó con 39 personas elegidas al azar (11 de las cuales eran artesanas) y en una segunda con 32 artesanas. Se realizaron entrevistas semiestructuradas y estructuradas. Se detectaron 11 y 57 especies tintóreas, 10 y 2 mordientes, en el primer y segundo período respectivamente. Ha aumentado el uso de órganos blandos en relación al de raíces y cortezas. Los colores obtenidos son pasteles en su mayoría. Se halló que las madres son las principales transmisoras de estos conocimientos, no obstante, actualmente cobraron importancia nuevos mecanismos de adquisición y transmisión. La aplicación de los resultados de este estudio puede proveer alternativas para la diversificación y la calidad de las artesanías actuales.

Key Words: Knowledge, processes of change, manufacturing, Los Toldos, Salta.

Introduction

Ethnobotanical research is a useful tool for identifying uses of plants and associated knowledge, as well as mechanisms of knowledge acquisition and transmission. It is the core of understanding traditional ecological knowledge, which now also includes an analysis of how this knowledge is adapted, linked, and transmitted through generations (Lozada et al. 2006). It is often assumed that traditional knowledge is characterized by resistance

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to adaptation or change over time (Ingold 2000). Changes in knowledge, according to this view, should be interpreted as errors in the transmission process, or as loss of traditional status. However, if it is taken into consideration that each individual has the ability to generate knowledge and experience, both on a personal and community level, this assumption has to be rejected (Holl 2005). While tradition is often perceived as a symbol of identity, it is important to pay attention to creativity in the adapting process (Davidson-Hunt 2006).

Cultural transmission is a process of social reproduction in which the technological knowledge of a given cultural group, along with its behavioral patterns, beliefs, and cosmologies are communicated and acquired. Many different forms of knowledge transmission have been defined based on a group's genealogy: 1) horizontal, which occurs among individuals of the same generation, 2) vertical, which takes place between different generations belonging to the same genealogy, and 3) oblique, which occurs when knowledge is passed from an older to a younger generation, not belonging to the same genealogy. Similarly, considering the number of senders and receivers of knowledge, two opposing modes of transmission are distinguished: From one person to many (e.g., teacher to students) and from many to one (e.g., an immigrant in a receiving community). Understanding these mechanisms may enable us to not only predict the cultural stability and variability of a group over time, but also to infer the evolutionary process of that group (Aunger 2000; Hewlett and Cavalli-Sforza 1986; Lozada et al. 2006).

Women have been identified as the principal transmitters of knowledge in Mapuche communities (Eyssartier et al. 2008). Consequently, to analyze the influence gender exerts on these processes, women's importance in projects focusing on environmental and sustainable use should not be overlooked (Bingeman 2003; Eyssartier et al. 2008; Gupte 2004; Vázquez-García 2008; Voeks 2007).

In Argentina, both indigenous and mestizo dyeing practices include plant and animal material, as well as minerals. Dyes of less technologically advanced groups were based on the use of fermented organic materials, whereas among Andean communities the decoction method predominated. The literature from the latter half of the 20th century mentions dyeing resources, describes the processes involved, and provides detailed information about the most common mordants, such as lye made with the ash of several plants, *talvina* or *chuia* made from wheat or corn flour, fermented urine, and salt water, among others (Marzocca 1993; Millán de Palavecino 1953).

The techniques currently used in Andean regions exhibit a long tradition of influence by Spanish colonists, particularly in the use of synthetic dyes and mordants (Fabbio et al. 2009; Fester 1962; Millán de Palavecino 1953). In the mid–19th century, synthetic dyes became popular due to their greater color range, the brighter and more vivid shades they offered, and simpler color fixing, to the detriment of the employment of natural dyes (Cárdenas 1989).

In the Los Toldos municipality, the production of handicrafts is a new economic activity. This includes wool products (such as bags, blankets, shawls, other clothing, and livestock management items) as well as wooden and clay objects. In general, these products are destined for home utilization; however, there are some local artisans who provide crafts for the whole village. Nowadays, this activity is almost exclusively reserved for women. Plants or purchased anilines are used for dyeing clothes (Fabbio et al. 2009; Hilgert 2007; Zardini and Pochettino 1983). The use of dyeing plants in this region has been mentioned in previous ethnobotanical studies (Fabbio et al. 2009; Hilgert 1998, 2007; Levy Hynes 1994; Zardini and Pochettino 1983).

Changes in market demands have influenced the re–evaluation of the use of plant dyes in textile crafts among the inhabitants of Los Toldos municipality. In response, some workshops and courses are being run, and artisans themselves have organized cooperatives and housewives clubs, where they begin to share their knowledge about dyeing with plants. Our hypothesis is that these changes have affected the use of dyeing species, as well as related mechanisms of knowledge production and transmission. We anticipate that the revived interest in handmade textile production has led to an increase in frequency of use and in the number of species used to dye wool. Moreover we expect that matrilineal influence has lost importance in the acquisition and transfer of knowledge in comparison with other factors.

To investigate this, we: 1) gathered data on plant dyes, including local and scientific names, plant parts used, colors and shades obtained through dyeing, modes of preparation, and the amount of material needed to achieve the desired shades and plant gathering seasons, and 2) analyzed forms of knowledge acquisition and transmission, and changes resulting from the recent revival of textile crafts in the region.

Material and Methods

Research was carried out in the rural communities of the Yungas in the upper basin of the Bermejo River. Settlements included Baritú, El Arazay, La Misión, Lipeo, Los Toldos, and El Condado, located in the municipality of Los Toldos, Santa Victoria department of the province of Salta. Due to their geopolitical location and history, these communities maintain relationships with Bolivian communities (Fig. 1).

These settlements are inhabited by descendants of different Andean indigenous groups that were influenced by Spanish culture. They speak only Spanish, although many Quechuan expressions are found in their speech. Most live in marginal socio–economic conditions. A brief analysis of the regional economy shows the coexistence of shifting agriculture, transhumance, nomadic cattle–breeding, hunting and fishing, and paid employment (Hilgert and Gil 2006).

The local vegetation forms a part of subtropical mountain forest—the Yungas—and the dominant species vary along an altitudinal gradient. In the highest sector, *Podocarpus parlatorei* Pilg., *Alnus acuminata* Kunth, and *Ilex argentina* Lillo predominate; the lowest parts are characterized by *Cinnamomum porphyria* (Griseb.) Mez, *Nectandra cuspidata* Nees & Mart. ex Nees, *Blepahrocalyx salicifolius* (Kunth) O. Berg, *Cedrela angustifolia* DC., and *Juglans australis* Griseb. The climate is tropical continental with warm rainy summers and cool dry winters; the mean annual temperature ranges from 14ºC to 25ºC (Bianchi and Yañes 1992; Cabrera 1976).

Field research was based on participant observation, semi–structured, and structured surveys. Additionally, an exhaustive review of available literature on the topic was carried out. Thirty–nine interviews were conducted with randomly chosen participants (of which 11 were artisans) in Baritú, El Arazay, El Condado, Lipeo, and Los Toldos, (information gathered between 1994 and 2000).

The second stage of the research was carried out between November 2007 and October 2008 (hereafter referred to as at present). In this stage we concentrated on dyeing plants. We worked with 32 artisans from El Arazay, El Condado, La Misión, and Los Toldos. We used the snowball sampling technique to recruit a group of participants (Bernard 2000). Local experts and/or persons active in the textile and dyeing crafts were selected as key informants, and those interested in participating in the study were interviewed. No prior information was available on the total number of artisans in the region. According to our estimate, there are 53 artisans working with traditional dyeing techniques. Of these, 60% (32) participated in individual, semi–structured, and structured interviews. We inquired about the species used in the preparation of plant dyes and about familiar dye resources that are not necessarily employed at present. The interview questions also concerned the sources of this knowledge, plant names, plant parts used, the amount of material required, the units of measurement used locally, dyeing techniques, colors obtained from dyeing processes, use of mordants, color mixtures, collection times, and local techniques of plant management. The information was recorded in field notebooks and on a voice recorder.

We collected 101 specimens in the places from which the artisans usually obtained them. The botanical material was identified by Alejandra Lambaré under the guidance of Norma Hilgert. The voucher specimens are stored in Herbario del Museo de Farmacobotánica, Facultad de Farmacia y Bioquímica, Universidad de Buenos Aires (BAF). We estimated the mean and standard deviation of species used per person with the data gathered at both stages. With the data obtained in the second stage, dedicated exclusively to the dyeing plants, we estimated the frequency of use per species ($FU = [f_n/N]100$) and compared the number of species in each locality by a chi–square test.

In the second stage of the survey, data were collected on two successive occasions with the aim of investigating the knowledge source and its transmission. First, during the semi–structured interviews, the inquiry was oriented towards the identification of locally recognized modes of knowledge acquisition. Then, based on the information already gathered, all the artisans were asked about more specific aspects of the subject. It was estimated if any learning modes and knowledge transfer prevailed in the region (the sum of all the localities) as well as for each of the four settlements. For that, we made a comparison among frequencies of citations of each mode with the expected average from a random distribution using a chi–square test.

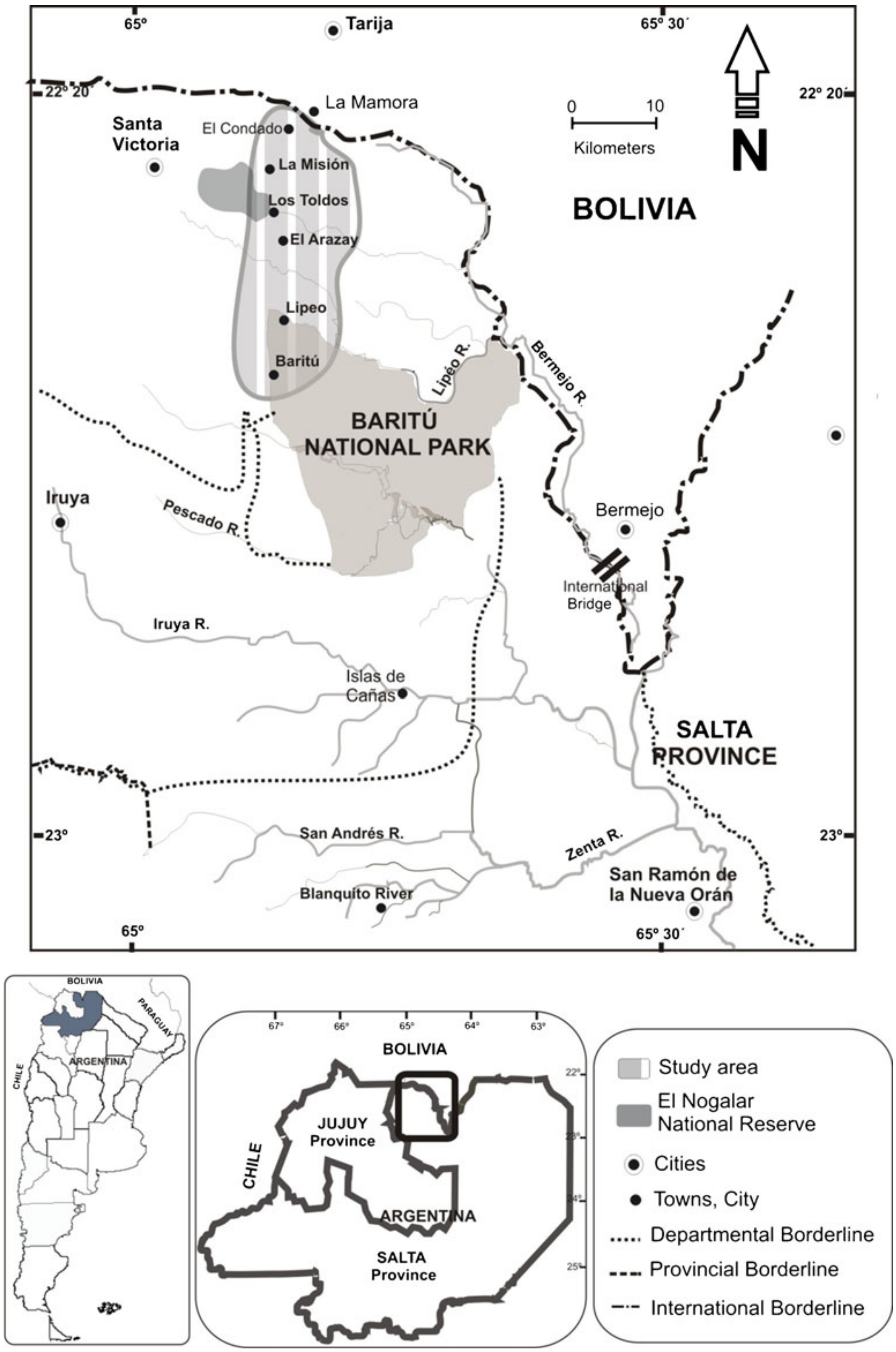

Fig. 1. Dye plant study area in northwest Argentina.

Results

The Textile Crafts and Plant Dyes

In the course of research on useful plants (first stage), we found that dye species and mordants were mentioned in 39% of the interviews. In the second stage, we determined that the development and trade of handicrafts is carried out primarily by women organized into cooperatives and groups. In Los Toldos, the largest town in the area, there are craft shops where artisans display and sell their work. Textile crafts include bags, blankets, tablecloths, table runners, and clothing made from sheep and, to a lesser extent, llama wool. The wool is in part produced locally, and bartered or purchased from vendors who come from neighboring villages on higher and drier ground. The llama wool is brought from La Quiaca and other localities of Bolivia.

Until about eight years ago, almost all the artisans preferred synthetic dyes, except for one or two species that have always been used. However, we observe that the local artisans are increasingly experimenting with new dyeing plant species in search for new colors, and are combining different species together, which is a new phenomenon. Nevertheless, mixtures of natural and synthetic dyes were not reported. This recent interest in plants is based on several reported advantages, including better acceptance by the purchaser, greater resistance of colors, easier availability of plant material, and reduced water pollution. Artisans generally use plant dyes for pieces to be sold and synthetic dyes for home use, as the bright and vivid colors obtained from synthetic dyes are locally particularly appreciated.

In the second stage of the research, 57 species of dye plants were reported belonging to 36 families and 55 genera. These include taxa known for their dyeing properties but not currently employed. Asteraceae (7) and Fabaceae (7) represent the highest number of species. Plant life forms included 7 herbs, 15 shrubs, 29 trees, and 6 vines or epiphytes. Native species accounted for 68.4% of the reported dyeing plants, followed by cultivated (21%), naturalized (8.7%), and purchased (3.5%) (Table 1).

J. australis, *Berberis lilloana* Job, *Ilex paraguariensis* A. St. –Hil., *Allium cepa* L., and *Anadenanthera colubrina* (Vell.) Brenan var. *cebil* (Griseb.) Altschul are the highest–ranked species with dyeing properties (Fig. 2). When comparing the number of species employed in each locality with the total, significant differences were found ($\chi_3{}^2 = 5.77$; $p = 0.05$). This means that there is not a uniform list of species used in the region, neither in number nor in composition. The number of species included 25 in El Arazay, 15 in El Condado, 20 in La Misión, and 41 in Los Toldos (Fig. 3). A comparison of the information gathered during both research stages shows the current increase in the number of species used in dyeing and, by contrast, the decrease in the number of plant mordants (Table 2).

The use of particular plant parts in dyeing varies according to the seasons. The artisans also reported that at different stages of plant growth—young, adult, and old, in the case of trees and shrubs—different shades are obtained from the same plant organ. A similar observation was made in relation to the phenological changes of an individual plant, such as leaf buds, young leaves, and old leaves that produce different shades of dye. For example, buds and young leaves of *J. australis* produce lighter shades than older leaves.

The material that is used in dyeing can be fresh, dried, or fermented. In recent years new plant organs have been incorporated, such as leaves and flowers, and at present these plant parts are more often used than those previously employed. Indeed, the plant parts most commonly used are leaves and aerial parts (branches, stems), followed by flowers or inflorescences and fruits. At the same time bark, cataphylls, roots, fronds, seeds, and resin are less frequently chosen (Fig. 4; Table 1). *J. australis* is the species with the highest number of citations and, at the same time, the species with the highest number of plant organs employed, followed by *B. lilloana* (Table 1).

Colors obtained from natural dyes depend on the dye concentration, the plant part used, the season in which the material is collected, the growth stage of the plant, and the employment of mordants. Pastels predominate among the shades. Green and yellow colors are obtained from the greatest variety of species (Fig. 5). Different shades of brown, especially those derived from *J. australis,* are usually employed as the basic color of pieces, to which different embroidered figures are applied. On the contrary, violet, pink, gray, and orange are used to weave embroidery patterns and borders.

At present, the artisans have set about the task of obtaining natural dyes in the range of red and blue. They base their search for new species on

Table 1. Dye species used in the municipality of Los Toldos, Northwest Argentina.

Species (Family), Local name, Vouchers	Life form	Provenance	Plant part used	Obtained color	Mordants
Acacia aroma Gill. ex Hook. & Arn. (Fabaceae), Tusca, L 64, 68 BAF	Tree	Na	Bark, fruit, and resin	Black; pale and dark green; pink; opaque red	Alum; citrus juice; urine
Acacia caven (Molina) Molina (Fabaceae), Churqui, L 65, 67 BAF	Tree	Na	Bark and fruit	Black	Alum; citrus juice; urine
Achyrocline sp. (Asteraceae), Suncho, L 77 BAF	Herb	Na	Flower and leaves	Yellow	Alum; vinegar
Aff Usnea angulata Ach. (Parmeliaceae) Bryophyta, Sacha verde, bejuco, L 23 BAF	Epiphyte	Na	Entire plant	Green	Alum
Allium cepa L.(Alliaceae), Cebolla, L 95 BAF	Shrub	C	Cataphylls	Yellow; burgundy; pale pink; green; orange	Alum; salt; vinegar
Alnus acuminata Kunth (Betulaceae), Aliso, L 60 BAF	Tree	Na	Leaves and bark	Green; orange; red; brown	Alum; citrus juice; vinegar; *talvina*[3]
Amaranthus hybridus L.(Amarantaceae), Aroma, L 38, 42, 46, 62 BAF	Shrub	C	Inflorescence	Yellow	Alum
Anadenanthera colubrina (Vell.) Brenan var. *cebil* (Griseb.) Altschul (Fabaceae), Cebil colorado, L 51, 58 BAF	Tree	Na	Bark	Red	Alum; citrus juice; urine
Baccharis dracunculifolia DC. (Asteraceae), Chilca, prementina, L 18, 28, 35 BAF	Shrub	Na	Leaves and stems	Green	Alum; salt; vinegar
Baccharis microdonta DC. (Asteraceae), Tola, L 29, 31, 34, 45 BAF	Shrub	Na	Leaves	Green	
Berberis lilloana Job (Berberidaceae), Palo Amarillo, L 25, 41, 74 BAF	Tree	Na	Leaves, bark	Yellow	Alum; citrus juice; vinegar; salt; urine
Beta vulgaris L. ssp. *vulgaris* (Chenopodiaceae), Remolacha, L 94 BAF	Shrub	C	Root	Purple; red	Salt
Bidens pilosa L. var. *minor* (Blume) Sherff (Asteraceae), Saetilla, L 51 BAF	Herb	Na	Flower	Green	Alum
Bocconia integrifolia Humb. & Bonpl. (Papaveraceae), Mil hombres, gavilán, L 54, 81 BAF	Tree	Na	Bark, leaves	Yellow	Alum; citrus juice; salt
Camellia sinensis (L.) Kuntze (Theaceae), Té, L 98 BAF	Shrub	P	Leaves and stems	Brown	Vinegar
Cedrela angustifolia DC. (Meliaceae), Cedro	Tree	Na	Bark	Pink	Alum; citrus juice; salt
Citrus sp. L. (Rutaceae), Naranja, L 89 BAF	Tree	N	Leaves and fruit's peel	Pale green	
Dahlia spp. (Asteraceae), Dalia, L 101 BAF	Shrub	C	Flower	Purple	Alum
Enterolobium contortisiliquum (Vell.) Morong (Fabaceae), Pacará, timboi, L 90 BAF	Tree	Na	Bark	Pale green	

Erytrhina falcata Benth. (Fabaceae), Ceibo, L 83 BAF	Tree	Na	Flower	Red	
Eucalyptus ssp. (Myrtaceae), Eucalipto, L 86 BAF	Tree	C	Leaves	Green	Alum
Zanthoxylum coco Gillies ex Hook. f. & Arn. (Rutaceae), Sauco, cochucho, L 56, 71, 75 BAF	Tree	Na	Leaves, bark, fruits, and resin	Yellow	Alum; citrus juice; urine; salt
Galium ssp. (Rubiaceae), Chapi	Herb	Na	Leaves and stems	Red	Alum; salt
Gladiolus sp. (Iridaceae), Gladiolo, L 100 BAF	Shrub	C	Flower	Red	Alum
Hydrangea macrophylla (Thunb.) Ser. (Hydrangeaceae), Hortensia, L 99 BAF	Shrub	C	Leaves	Green	
Hypolepis repens (L.) C. Presl (Dennstaedtiaceae), Helecho, L 21 BAF	Fern	Na	Fronds	Green	
Ilex paraguariensis A. St. -Hill. (Aquifoliaceae), Yerba, L 97 BAF	Shrub	P	Branches, stems, and leaves	Green	Alum; urine; salt; vinegar
Jacaranda mimosifolia D. Don (Bignoniaceae), Jacarandá, tarco, L 87 BAF	Tree	Na	Flower	Purple	
Juglans australis Griseb. (Juglandaceae), Nogal, L 22, 39 BAF	Tree	Na	Bark, leaves and fruit	Brown	*Quechincha*[4]; citrus juice; salt; vinegar
Ligaria sp. (Loranthaceae), Liga	Vine	Na	Leaves and flowers	Yellow; red	Salt; vinegar
Dolichandra unguis-cati (L.) L.G. Lohmann (Bignoniaceae), Uña de gato, L 66 BAF	Vine	Na	Leaves	Green	
Mespilus germanica L. (Rosaceae), Níspero, L 91 BAF	Tree	C	Leaves	Pale pink	Salt
Morus sp. (Moraceae), Mora, L 88 BAF	Tree	N	Fruits		Alum; urine; citrus juice
Myrsine coriaceae (Sw.) R. Br. (Myrsinaceae), Yuruma, L 30, 55 BAF	Tree	Na	Fruits and leaves	Brown	Alum
Parapiptadenia excelsa (Griseb.) Burkart (Fabaceae), Cebil moro, L 53 BAF	Tree	Na	Bark	Purple	
Passiflora umbilicata (Griseb.) Harms (Passifloraceae), Granada	Tree	C	Fruit's peel	Unknown	
Persea americana Mill. (Lauraceae), Palta, L 92 BAF	Tree	N	Seeds	Yellow; brown	Citrus juice; vinegar
Piper aduncum L. (Piperaceae), Matico	Herb	Na	Leaves	Green	Alum; salt
Podocarpus parlatorei Pilg. (Podocarpaceae), Pino criollo, pino del cerro, L 44 BAF	Tree	Na	Bark, root and seeds	Brown	Alum; citrus juice
Populus alba L. (Salicaceae), Álamo, L 82 BAF	Tree	C	Leaves	Green	Alum
Prunus persica (L.) Batsch (Rosaceae), Duraznero, árbol, L 85 BAF	Tree	N, C	Leaves	Pale green	Alum; citrus juice; *talvina*; vinegar
Rosa rubiginosa L. (Rosaceae), Rosa, L 93 BAF	Shrub	N, C	Flower	Pale red	Alum
Rubus imperialis Cham. & Schltdl. (Rosaceae), Mora silvestre, L 70, 76 BAF	Shrub	Na	Leaves	Green	

TABLE 1. (CONTINUED).

Species (Family), Local name, Vouchers	Life form	Provenance	Plant part used	Obtained color	Mordants
Rumex sp. (Polygonaceae), Lampazo, L 72 BAF	Herb	Na	Leaves	Green	
Salvia atrocyanea Epling (Lamiaceae), Salvia, L 26, 40 BAF	Shrub	Na	Leaves	Green	
Sambucus nigra L. subsp. *peruviana* (Kunth) R. Bolli (Adoxaceae), Mololo, L 20, 24, 43 BAF	Tree	Na	Fruits	Purple	Alum; salt
Sapium glandulosum (L.) Morong (Euphorbiaceae), Lecherón	Tree	Na	Leaves	Green	Salt; vinegar
Senecio bomanii R. E. Fr. (Asteraceae), Cosillo, L 33, 50, 57, 79 BAF	Shrub	Na	Leaves	Green	
Solanum betaceum Cav. (Solanaceae), Chilto, tomatito, L 84 BAF	Tree	Na	Fruit	Yellow	
Solanum sisymbriifolium Lam. (Solanaceae), Vila vila, L 49 BAF	Herb	Na	Fruit	Red	
Tagetes terniflora Kunth (Asteraceae), Suico, L 47 BAF	Herb	Na	Leaves	Yellow	
Tecoma stans (L.) Juss. ex Kunth (Bignoniaceae), Guaranguay, L 32, 48, 59, 61, 63 BAF	Tree	Na	Leaves and flowers	Yellow	Alum
Tillandsia usneoides (L.) L. (Bromeliaceae), Sacha blanca	Epiphyte	Na	Entire plant	Green	
Tipuana tipu (Benth.) Kuntze (Fabaceae), Tipa, L 52 BAF	Tree	Na	Bark	Brown; pink orange; green	Alum; citrus juice; urine; salt; vinegar
Vassobia breviflora (Sendtn.) Hunz. (Solanaceae), Uchucho, L 27, 36 BAF	Shrub	Na	Fruit	Orange	Alum; salt
Xylosma longipetiolata Legname (Salicaceae), Supa supa, L 20, 24, 43 BAF	Tree	Na	Bark and leaves	Pink	Alum; citrus juice; vinegar; salt
Zea mays L. (Poaceae), Maíz, L 96 BAF	Shrub	C	Stamen	Lime green	

Native: Na; Cultivated: C; Naturalized: N; Purchased: P
[1] Alum (*millo*): double sulfate of aluminum-potassium.
[2] Adventitious citrus: "naranja agria" (*Citrus aurantium* L.) and "limón" (*Citrus limon* (L.) Osbeck).
[3] *Talvina* or *chuia* of maize: residual substance obtained during maize fermentation for maize beer (chicha).
[4] *Quechincha*: soot accumulated on the kitchen's walls close to the stove.

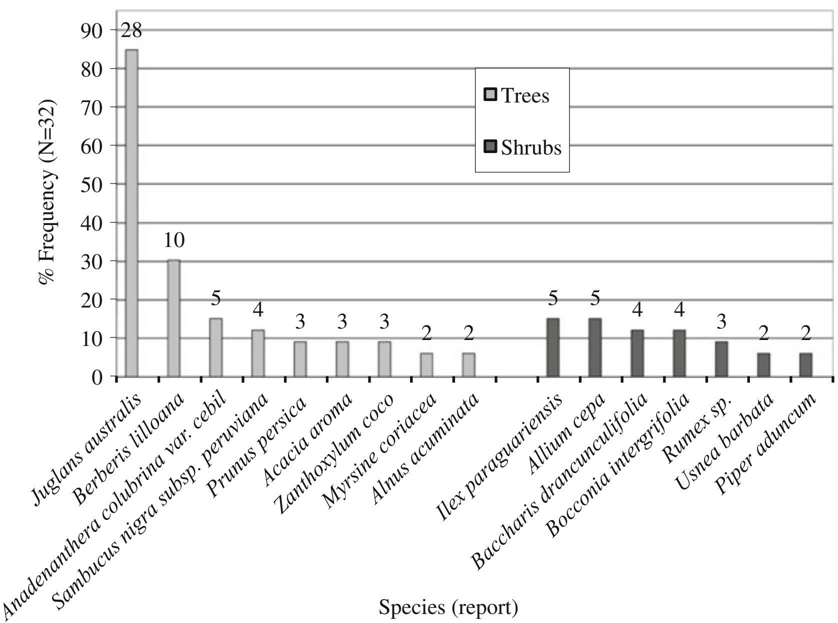

Fig. 2. Most frequently used dye plant species in Yungas communities of northwest Argentina.

observations made during daily activities such as weeding and plot cultivation. The indicators are stains on the body and clothes. Occasionally two or more plant species are mixed to increase the range of colors.

The Dyeing Process

The dyeing process consists of several steps: Washing of fibers, use of mordants before or after dyeing (optional), dyeing, rinsing, and drying. The time during which the wool is submerged in the dye, the use of heat and/or the fermentation of the mix vary according to the expected color and the criterion of the artisan. The color is extracted in different ways: a) the plant material is boiled and used immediately, or prepared in the morning and left until noon, b) plant material is left in water to ferment until the desired color is obtained, and c) plant material is placed in boiling water, but removed from the fire and left for a few hours. The first option is the most widely used. Fixing colors with mordants depends on the plant material; it is done before or after dyeing the fiber.

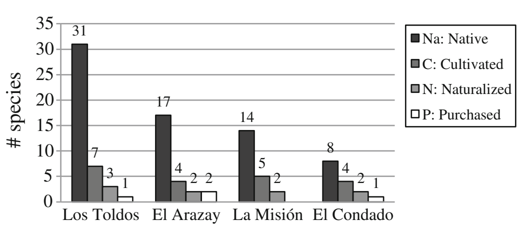

Fig. 3. Dyeing plants in different settlements.

There are different kinds of mordants depending on the mode of preparation and color to be obtained (Fig. 6). The most widely used is alum (locally called *millo*, a double sulfate of aluminum–potassium), which was introduced together with synthetic dyes. Fermented mordants are elements of the old dyeing tradition and are largely abandoned today. Urine is stored in plastic bottles to be fermented. *Talvina* or *chuia* is a product of corn beer fermentation (*chicha de maíz*). Fermented mud is locally known as "*barro de ciénaga*"; it is black, dense, and has a strong smell. Soot, locally called *quechincha,* is obtained from ashes accumulated on the kitchen roof.

Mud and soot are used exclusively for dyeing wool black or dark brown. Their use represents an old means of creating brown dye; *J. australis*'s bark, mud, and soot are mixed together in a process known as *nogaliado*. Nowadays the same technique is employed with leaves of *A. acuminata* and *J. australis*. A few artisans still use a mixture of "bog mud" and "red earth" (with iron salts), or use rust water made of screws and nails to obtain a gray color (Fig. 6). The preparations that include substances with iron are used exclusively for dyeing wool black or dark brown.

Table 2. Use of dye species and mordants used at different periods in the study region.

	1994–2000	Present
# of dye species	11 (10 families and 10 genera)	57 (36 families and 55 genera)
Mean	3.28	8.34
Standard deviation	2.95 (1–10)	3.6 (3–18)
# of mordant species	10 (4 families and 4 genera)	2 (1family and 1 genus)

On occasion, such as when a new species is used, a test for color fastness is carried out. For this purpose, a dyed skein is left in the sun for several days. If the color has altered, the yarn is dyed again.

Knowledge Sources and Transmission

We identified different modes of knowledge acquisition and/or transmission associated with the development of plant dyes. Sometimes training begins in childhood; in other cases, it forms part of a recent innovation in production. On a regional scale, we found mothers to be the main source of knowledge, followed by training and workshops (organized since the late 20th century), exchange of information among peers, grandmothers' teachings, individual searches, and personal experience. These results were highly significant ($\chi_4^2 = 25.56$; $p < 0.01$).

However, these proportions change when each site is analyzed independently. In La Misión, knowledge comes exclusively from workshops and personal learning. In the remaining settlements the primary sources are mothers, followed by personal learning and training at workshops. Los Toldos is the only place where grandmothers' teachings and exchanges of experiences with other persons are mentioned as sources of knowledge (Table 3). The unique localities where there was a significant difference with respect to the sources of knowledge were El Arazay ($\chi_4^2 = 10.75$, $p < 0.05$) and Los Toldos ($\chi_4^2 = 13.43$; $p < 0.01$).

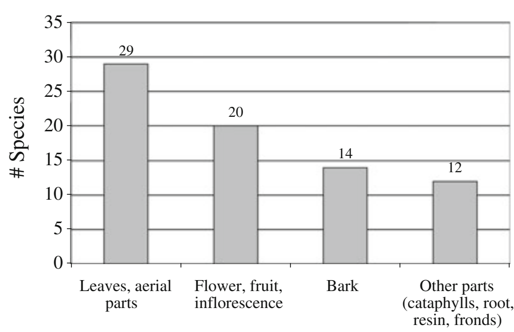

Fig. 4. Plant parts used in the dyeing process.

The analysis of knowledge transmission, done in a similar way, shows that there are no significant differences among the settlements; however a trend exists when we compare all localities together with random expected ($\chi_2^2 = 4.95$; $p < 0.1$). This is due to the prevalence of vertical transmission (from mother to daughter) in most localities, followed by oblique transmission (from training staff in community workshops, grandmothers, and mothers–in–law) and horizontal transmission (among peers from the housewives club) (Table 3).

Local workshops have different goals. For some, the main concern is stimulation of the artisans' personal search for dyeing alternatives, putting an emphasis on the native flora. Others have a classic format—explaining and teaching the use of certain species. *A. cepa, I. paraguariensis*, *Persea americana* Mill., and *Prunus persica* (L.) Batsch are species that are starting to be used as a result of workshops.

Discussion

The Textile Crafts and Plant Dyes

We found 57 botanical species currently involved in dyeing activity in the study area, which significantly raises the number of species

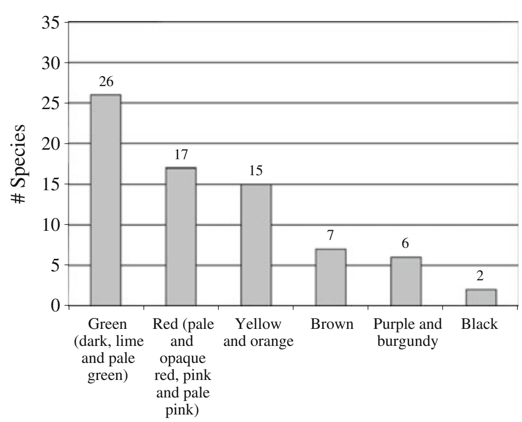

Fig. 5. Richness of dye plant species providing different colors.

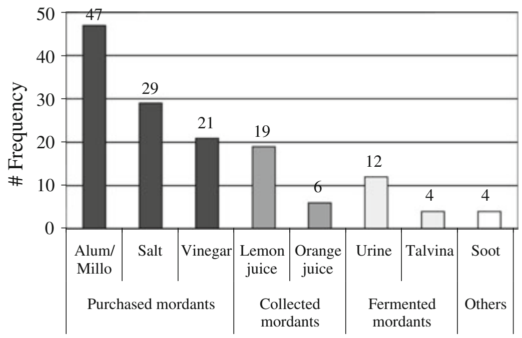

Fig. 6. Use frequency of employed mordants.

cited in previous publications for the same region and its surroundings. Indeed, Zardini and Pochettino (1983) mentioned the use of bark of *J. australis* and *A. colubrina* var. *cebil*, and inflorescences of *B. lilloana*. Levy Hynes (1994) cited three species in the town of Los Toldos. In both cases, the species mentioned are included in our list. Hilgert (1998) found seven plant taxa used for dyeing in rural communities in the same habitat, but a little further to the south in the Orán department, of which six were reported in our study area. Moreover, Hilgert (2007) reported 25 species with dyeing properties in the entire Bermejo River upper basin, of which 17 coincide with those from our study.

The increase in the use of dyeing species reported in this study reflects a growing appreciation for natural dyes. A likely explanation is the current market demand resulting from ecotourism and cultural tourism. This potential source of income has encouraged artisans to search for new colors employed in crafts, to participate in workshops, to exchange their experiences, and to organize themselves into public or private bodies.

Our research documents precise knowledge about the dyeing qualities of plants, the suitable moment for employment of plant organs, the seasonal variation for each species and occasional individual variation within the same species. In all cases, the artisans who provided the detailed information have a pivotal interest in crafts and the conservation of traditional techniques, as well experimentation with new species and craft techniques.

Previous findings largely documented the use of tree roots and bark. This study discovered a diversification of plant part use and observed changes in use frequency. Flowers, leaves, and fruit were incorporated, while the use of woody parts has decreased. Artisans who experienced difficulties in procuring certain plant resources likely drove these changes. These innovations were successfully adopted by artisans once they experienced the dyeing properties of non–woody organs and appreciated the greater variety of available colors, as well as the easier gathering techniques and handling compared to woody parts.

The Dyeing Process

Coloring with natural dyes is a laborious process carried out by decoction and/or by fermentation, or alternation of both methods. According to the regional literature, the use of mordants has been undergoing a gradual change. The most common mordants in the past, which were obtained from fermented materials (urine, corn products, and mud) and/or lye from plant ashes, were later replaced by alum (Millán de Palavecino 1953; Tavera de Téllez 1989). Tavera de Téllez (1989) and Hilgert (1998, 2007) mention the use of two native species as mordants: "querusilla" (*Gunnera apiculata* Schindl.) and "alaituya" (*Begonia* spp.). In this study, we only observed the juice of bitter orange (*Citrus aurantium* L.) and lemon (*Citrus limon* [L.] Osbeck) being used for this purpose. Alum, locally called *millo*, is a foreign product early incorporated by the Yungas communities. Not only is it used in dyeing, but it also plays an important role in local medicine as it is used to treat some folk illnesses (*limpias*, *alumbriadas*). Along with coca (*Erythroxylum coca* Lam.), *millo* displays utilitarian and symbolic values and serves as a cultural marker in these communities (Hilgert and Gil 2006).

The introduction of synthetic dyes marked a gradual reduction in the use of natural dyes (Cárdenas 1989; Fester 1962; Millán de Palavecino 1953). Synthetic dyes are widespread and have been incorporated into the local handicrafts. This is particularly evident in the study area, where synthetic dyes are applied to the embroidered garments destined for family use.

Knowledge Sources and Transmission

Knowledge of the dyeing properties of botanical species is a part of women's cultural heritage. We did not find any male artisans involved in this activity. The importance of

Table 3. Knowledge sources and transmission.

% Observed (# report) [# informants]	Vertical	Oblique		Horizontal	
	Mothers	Grandmothers	Workshop, training	Other (mother in law, club mate)	Personal experimentation
El Arazay [5]	62.5 (5)		12.5 (1)	25 (2)	
Los Toldos [19]	46.4 (13)	10.7 (3)	17.8 (5)	17.8 (5)	7.1 (2)
La Misión [4]			75 (3)	25 (1)	
El Condado [4]	60 (3)		20 (1)	20 (1)	
Total [32]	46.6 (21)	6.6 (3)	22.2 (10)	20 (9)	4.4 (2)

women in the transmission and preservation of knowledge associated with local use of flora has been widely cited in the ethnobotanical literature, as has the importance of incorporating women into sustainable use projects and in the promotion of cultural values (Bingeman 2003; Eyssartier et al. 2008; Gupte 2004; Lozada et al. 2006; Vázquez-García 2008; Voeks 2007).

Analysis of the forms of knowledge transfer from one generation to another may reveal the dynamics and adaptive qualities of a local culture, as well as how the local processes of traditional knowledge transmission can reinforce a particular type of knowledge (Garibay-Orijel et al. 2007). Vertical transmission is a highly conservative feature of traditional communities. Where it forms the most important pattern of transmission, it can impede the spread of innovations. However, if other forms of cultural transfer are involved, such as from one individual to many and/or horizontal, then transmission is highly efficient and cultural change may occur relatively quickly (Hewlett and Cavalli-Sforza 1986). The age of the knowledge receiver is also important in the acquisition process; vertical transmission declines in adulthood and personal experience predominates (Aunger 2000). Indeed, an array of factors help shape the knowledge and use of resources—geographical factors such as distance to urban centers (Hilgert and Gil 2006), the validity of past practices (Zardini and Pochettino 1983), and social factors such as the emergence of new markets that stimulate the spread of knowledge. These factors facilitate the incorporation of external trainers and promoters and discussion among peers, and also encourage personal experimentation.

We discovered that the main sources of knowledge in this study are mothers, followed by formal training and exchange among peers. When considering modes of transmission, vertical transmission predominates, followed by the oblique. The latter can be ascribed largely to extension workers and workshop trainers. As proposed by Hewlett and Cavalli-Sforza (1986), the participation of extension workers results in more efficient dissemination of new knowledge and its reception among the artisans of the municipality. Thus we can establish a predictive model of changes related to this activity. The importance of different forms of knowledge transfer changes during the lifetime of every individual. In adulthood, personal learning—regulated by the idiosyncrasies of each person as well as by environmental and socio–cultural changes—propels a search for adaptive responses individually or among peers (Berkes et al. 2000). These adaptive responses may generate large changes in the corpus of local praxis (Aunger 2000; Eyssartier et al. 2008). By analyzing the changes that have occurred in recent years and the attitude of those affected by these changes, we observe that the relational network in which the activity was immersed has also changed.

Conclusions

We conducted an ethnobotanical survey related to crafts and the use of dyeing plants in the municipality of Los Toldos, Argentina. We observed that the development of handicrafts based on plant dyes is a production strategy that supports the creation of a true "women's space" for meeting, exchange, and preservation of knowledge in the Yungas communities. Within textile craft production, individual and communitarian knowledge has been adapted to new market demands. The artisans' activity has been revalued, and new textile products have appeared with exclusive characteristics in the market. Changes have occurred in the number of botanical species used as well as mechanisms involved in knowledge transmission, inter–communitarian relations, and experimentation/observation of the cultural landscape. Matrilineal vertical transmission is the main mode of knowledge transmission, giving the mother a crucial role in knowledge acquisition and transmission. However, the influence of technical assistance in the community gives rise to a new transmission model. This new mechanism can be considered as a complementary tool to promote traditional crafts. Artisans should be encouraged and trained, and the search for natural dyes should be further developed as should the popularization of crafts and related activities, so that the artisans themselves can trigger mechanisms of transmission and knowledge exchange.

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