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Exploration and Inventory of Banjar Ethnochemistry as a Learning Source in Indonesia Senior High School Chemistry Context

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Abstract

Ethnochemistry is the study of chemical practices by specific cultural groups that are used for activities following the ideology of the community, including the Banjarese community. Banjar ethnochemistry can be integrated into science learning, especially for Indonesia's senior high school chemistry learning context. This study aims to analyze the results of exploring the local wisdom of the Banjarese community, which is included in ethnochemistry, and to take an inventory of Banjar ethnochemical knowledge as a source of Indonesia senior high school chemistry learning. The study uses an exploratory qualitative approach with ethnographic methods. The subjects in this research are community leaders and academics who understand Banjar ethnochemistry. Data collection techniques used interviews, observation, and documentation. The results of the Banjar ethnochemical exploration include Banjar soup, *sasirangan*, *basungu*, rub ash, *batimung, sepat* dry fish, diamond, *tanggui*, *tapai* Gambut*, laduman, kelakai,* ironwood, ironwood hair oil, fish *pentol*, *selangat* shredded fish, Mangurak wells, *mandai,* and *lahang* ice. An inventory of Banjar ethnochemical knowledge that can be used as a source for Indonesia senior high school chemistry learning consists of acids and bases, chemistry and its scope, alkane derivatives, macromolecules, elemental chemistry, and colligative properties of solutions.

Keywords: Banjarese community, chemistry learning resources, ethnochemistry, exploration, inventory

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1. Introduction

South Kalimantan has abundant natural and cultural wealth and is often used by its native people. The Banjar people are indigenous people who live in most of South Kalimantan (Fithria et al., 2014). This natural and cultural wealth can be classified as local wisdom, which is currently being encouraged to be explored and researched. For example, the essential oil composition of insulin leaves (*Tithonia diversifolia*) is used as a medicinal plant by the Banjar people to treat glycemia (Fauzi'ah & Hajati, 2020). In addition, Bangkal plants (Nauclea sp.) are wetland plants commonly used as cold fertilizers (Soendjoto & Riefani, 2013). The cold fertilizer is classified as one of the beauty products included in the local wisdom of the Banjar people.

Besides, the local wisdom or ethnoscience of the Banjar people needs to be recognized and

preserved. Ethnoscience is a unique knowledge of certain cultural communities (Jannah et al., 2022), which is different from other communities (Winarti et al., 2018). Studies in ethnoscience can be further divided into ethnobiology, ethnophysics, ethnochemistry, ethnomathematics, ethnomedicine, and agriculture and food processing (Nursaadah et al., 2017). Meanwhile, ethnochemistry is a part of ethnoscience related to studying chemical sciences. Added by Ajayi et al. (2017), ethnochemistry is a study of chemical practices by certain cultural groups that are used for activities following that society's ideology.

Some Banjar local wisdom can also be included in ethnochemistry, which the Banjar people commonly use in their daily activities. Several studies have identified the content of typical South Kalimantan plants, which the Banjar people can ultimately utilize. For example, identifying local South Kalimantan fruits' physical and chemical properties (Antarlina, 2016). Other studies have also explored the use of lime peel extract as a larvicidal agent for *Aedes Aegypti* (Ishak et al., 2019) and as an antibacterial for E. Coli and Staphylococcus aureus (Ariyani et al., 2018).

Banjar ethnochemistry can also be integrated into science learning, especially chemistry learning. Based on the 2013 curriculum, senior high school chemistry learning has seen a paradigm shift from behavioristic to constructivist. This change means that the knowledge transfer from teacher to student becomes an interactive process between teachers, students, the community, sources/media, and the surrounding environment (Fuad et al., 2018). Integrating ethnochemistry in senior high school chemistry learning can provide interactive processes with the surrounding environment. On the other hand, Ethnochemistry can be used as a learning resource that supports students' interaction with the environment. Regional ethnochemistry, such as South Kalimantan: frontier and outermost, can be a potential learning resource in science learning, including chemistry (Parmin & Fibriana, 2019).

Furthermore, the nature of the material in chemistry learning is compatible with life; it can be integrated with Banjar ethnochemistry. For example, teachers can use natural materials as examples of acidic and alkaline in everyday life, such as lime, swamp water, pumpkin, karamunting, and others. In addition, the ethnochemistry of the Banjar Sasirangan can be combined into a chemical worksheet: colloids in the coloring process and the resulting waste (Iriani & Kurniasih, 2019). This integration can improve students' critical thinking skills and cognitive, affective, and psychomotor learning outcomes (Iriani & Kurniasih, 2019). Besides, it also fosters students' social and cultural awareness (Rahmawati et al., 2018).

In contrast, the exploration and inventory of Banjar ethnochemistry as a source of chemistry learning has not been widely studied. Based on a literature search, researchers only found two articles discussing Banjar ethnochemistry as a source of learning chemistry. The first comes from Iriani & Kurniasih (2019), who developed an integrated worksheet on *sasirangan* (Banjar batik) in colloid learning. Meanwhile, Almubarak et al. (2021), developed a wetland-based chemistry module as an innovative learning media on buffer solution material. Therefore, chemistry teachers can use *sasirangan* and alkaline fields to teach chemistry on certain materials to students. The use of this material is based on the need for ethnochemistry. Also, these conditions are combined with a learning plan; while at the same time introducing students to local culture (Hadi & Ahied, 2017).

According to the literature review, the integration of ethnochemistry in chemistry learning in Indonesia is still limited to the regions of Aceh, Sasak, Baduy, Papua, Bali, Maluku, Central Java, and Yogyakarta. In the Papua region, the integration of ethnochemistry into learning can be carried out by utilizing Maro River water in electrolyte solution materials, ant nests in reaction rate materials, and *sago* flour in enthalpy changes (Asmaningrum et al., 2018).

On the other side, in the East Aceh tribe, ethnochemistry can be integrated into chemistry lectures covering natural ingredients used as medicines: food additives, beauty and cleaning tools and ingredients, appropriate technology, and processing of typical Acehnese food (Seprianto & Jofrishal, 2019). Meanwhile, the ethnochemistry of the Sasak, Lombok, and West Nusa Tenggara tribes can be integrated into learning chemistry in the concept of matter and its changes: separation and making of mixtures, atomic structure, periodic system of elements, and chemical bonds (Wahyudiati & Fitriani, 2021).

However, not many articles discuss Banjar ethnochemistry's use in learning; thus, it is necessary to carry out an exploration and inventory of Banjar ethnochemistry which can be used as a source of learning chemistry. This article aims to describe the results of exploring the Banjar people's local wisdom, including in ethnochemistry and an inventory of Banjar ethnochemistry knowledge as a source of learning chemistry in the senior high school context. Hence, the research results can benefit the wider community, especially academics, to continue developing chemistry learning resources integrated with Banjar ethnochemistry. In the future, preserving Banjar ethnochemistry through this integration can be achieved and foster a sense of social and cultural awareness for students.

2. Research Method

This study uses an exploratory qualitative approach with ethnographic methods. The ethnographic method is a way to explore and explore the concepts that exist in an event or phenomenon (Gulo, 2010). This research explores local wisdom in the form of natural wealth in South Kalimantan (Banjar), classified as ethnochemistry. The results of this exploration are integrated and adapted as a form of chemistry learning resource which can later be utilized in senior high school chemistry learning. The subjects in this study were community leaders and academics who understand Banjar ethnochemistry.

Data collection techniques using interviews, observation, documentation, and supporting journal article literature. The research instruments used were: 1) interview guidelines, which were used to explore/explore data related to Banjar ethnochemistry from informants/subjects; 2) observation guidelines, which were used to observe the process of ethnochemical knowledge of the Banjar people. Data analysis techniques use reduction, presentation, and conclusion (Miles & Huberman, 1992).

3. Result and Discussion

3.1. Exploration and Inventory of Banjar Ethnochemistry

Exploration and inventory of Banjar ethnochemistry as a source of learning chemistry for senior high school is focused on the following points: 1) Local traditions in the Banjar tribe area. Exploration and inventory of local traditions of the Banjar tribe include customs, culture, and religious ceremonies; 2) Local crafts in the Banjar tribe area. Exploration and inventory of local crafts include various kinds of local crafts produced by the Banjar people; 3) Local natural materials in the Banjar tribe area. Exploration and inventory of local natural materials consist of medicines, preservatives, dyes, food flavorings, and plant fertilizers; 4) Locally processed products are located in the Banjar tribe area. Exploration and inventory of locally processed products include food and beverages; 5) Appropriate technology in the Banjar tribe area. Exploration and inventory of appropriate technology include various kinds of appropriate technology used by the Banjar people.

This Banjar ethnochemistry exploration and inventory was carried out in eight areas in the province of South Kalimantan, which include:

3.1.1. Banjarmasin City

Banjarmasin City is the capital of South Kalimantan Province, nicknamed "The City of a Thousand Rivers." Banjarmasin has a fairly large area with several small islands separated by small rivers. The following are the results of

the ethnochemical exploration of the Banjarmasin area in Table 1.

Table 1. Ethnochemical Exploration and Inventory Results in the Banjarmasin City

No	Etnochemistry	Category	Description
1	Banjar Soup	Food	Banjar soup uses many Indonesian spices: shallots, garlic, anise, cloves, ginger, cardamom, cinnamon, pepper, nutmeg, and celery.
2	*Sasirangan*	Local crafts	Banjar traditional cloth is made by sewing cloth with a basting technique to make motifs. The making of *sasirangan* cloth is traditionally done with the stages of motif design, knitting, soaking, unknitting, washing, and ironing.
3	*Basungu*	Local tradition	*Basungu* or Banjar cupping aims to remove dirty blood from the body. Dirty blood can contain toxins, cholesterol, and uric acid. The process is carried out by sucking blood by removing it from the surface of the skin that has been sliced first.
4	Rub Ash	Local ingredients	Banjar people usually clean their teeth using rubbing ash made from activated charcoal.
5	*Batimung*	Local tradition	Traditional body care with evaporation or steam systems. The *batimung* process usually uses layered *purun* mats to hold the hot steam.

Five types of ethnochemistry in Banjarmasin City have been successfully explored and inventoried. The recorded ethnochemistry is classified into food, medicine, local crafts, and local traditions. The data were obtained from interviews with experts and lecturers in chemistry education at UNISKA who native Banjar people are.

Banjar soup is a typical Banjar food seasoned with spices. This spice contains flavonoid compounds that function as natural antioxidants that can counteract free radicals. The results of Sari's research (2016) state that high antioxidants are found in ginger, turmeric, and nutmeg, where these spices are used in making soto Banjar. The nutritional content of 100 grams of Soto Banjar is around 14.18% fat, 4.83% protein, and 2.40% sodium (Risqi, 2018).

Sasirangan is classified as a local craft in cloth patterned with certain techniques. *Sasirangan* comes from the word "*sirang*" (in the Banjar language), which means "panhandle." In contrast to *batik*, the pattern on the *sasirangan* cloth is drawn manually, then stretched to sew the pattern that has been formed (Jumriani et al., 2021). For coloring the *sasirangan*, use maceration techniques using synthetic or natural plant colors. In addition, coloring *sasirangan* can use cold or hot water, depending on the type of color used. Figure 1 shows an example of the Banjar *sasirangan*.

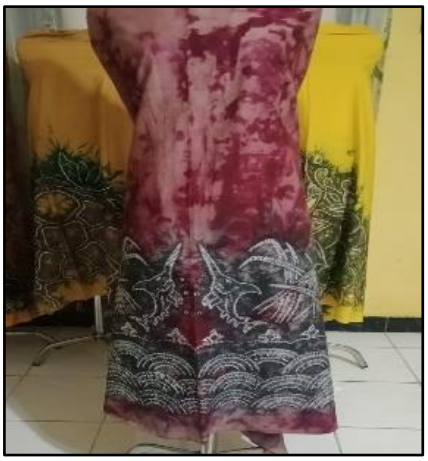

Figure 1. Banjar *Sasirangan* Cloth (Source: Personal documentation)

Synthetic colors commonly used in coloring *sasirangan*: Na_2SO_4, caustic soda, indanthrene color (hot water), naphthol color (cold water), and frozen (Nasruddin et al., 2018). However, using these synthetic colors can become a hazardous liquid waste for the river environment around the *sasirangan* home industry (Permatasari et al., 2021). This liquid waste can contain heavy metals that harm the environment. Some metals that can be contained in liquid waste are heavy metals lead (Pb), cadmium (Cd) (Rossi et al., 2014), and chromium (Cr) (Irawati et al., 2011).

Furthermore, the problem of liquid waste from the production of *sasirangan* cloth can be reduced by various methods, such as phytoremediation. This method can reduce levels of Pb^{2+} and Cd^{2+} with water hyacinth plants capable of absorbing heavy metals (Rossi et al., 2014). In addition, reducing the concentration of heavy metals can also use activated charcoal filters. The lead concentration (Pb) in *sasirangan* wastewater can be reduced through treatment with $FeSO_4$ coagulant, followed by filtration using chitosan-coated palm shells (Irawati et al., 2011).

Besides, the *sasirangan* coloring process can use natural dyes to produce more environmentally friendly waste. Materials commonly used for natural dyes are palm shells, cocoa, *heena*, mulberry (Lestari, 2019), and ironwood powder (Salsabillah et al., 2021). For the natural color to be bound to the patterned fabric, it must undergo a fixation or soaking process for a long time. After it, several substances were used in the fixation process, giving different shades, such as lime, alum, tunjung (Salsabillah et al., 2021), salt, and vinegar (Zaidah & Andriana, 2022).

The next discussion concerns *basungu*, which belongs to the local Banjar tradition. *Basungu* is the same as cupping or *hijamah*, which removes dirty blood from the body. This dirty blood is a dangerous substance or toxins that must be removed from the body (Malik, 2015; Sari et al., 2018). When doing *basungu*, the negative pressure exerted from the hot glass can increase the filtration of harmful substances so that they accumulate in the desired area (lobes) and can exit through the excretion process (Risniati et al., 2020; Sari et al., 2018).

The negative pressure can be obtained from a glass that is burned until it is extinguished, then cupped at a predetermined point. This process will cause hemolysis in damaged red blood cells, thereby increasing the excretion of fluids containing body toxins (Hidayati et al., 2019). These events follow the principle of osmotic pressure in the blood (Ahmed, 2015; Mahmoud et al., 2013).

Further is the discussion about the ashes used to clean teeth. Based on the results of an interview with the UNISKA Chemistry Education Lecturer, rubbing ash is alkaline, while saliva is acidic. If it is reacted, it can form neutral salt, which can clean teeth.

Rubbing ash containing activated charcoal can absorb anions, cations, and molecules in the form of organic and inorganic compounds. The absorption process makes activated charcoal a tooth whitener that can absorb materials attached to the surface of the teeth caused by the ingredients in tea, coffee, and cigarettes (Febrianti et al., 2021; Siregar, 2020).

The next local wisdom is *batimung,* which includes local traditions for body care and is usually carried out by the bride and groom. Batimung means a steam bath, like a sauna using natural herbs or flowers (Adiesia et al., 2016). Spices or flowers commonly used in *batimung* are citronellas, kaffir lime, roses, jasmine, ylang-ylang, galangal leaves, *dilam* leaf, and others (Rahmah, 2016).

In the *batimung* process, the body is covered with a *purun* mat or pandanus mat with a thick blanket (Saefuddin & Maryadi, 2018). This way is so that the steam produced from boiling spices or flowers does not come out. It can push sweat out of the body. This process is based on the thermochemical concept of the system and environment. In this case, the mats and cloth act as system boundaries so that heat does not escape from the system.

3.1.2. Banjar Regency (Gambut and Martapura)

Banjar is one of the regencies in South Kalimantan, which is classified as very large, with the capital city of Martapura. The results of ethnochemical exploration and inventory in Banjar Regency are shown in Table 2.

Table 2. Ethnochemical Exploration and Inventory Results in Banjar Regency

No	Etnochemistry	Category	Description
1	*Iwak Karing Sepat* (*Sepat* Dry Fish)	Food	*Sepat* fish is dried with the help of sunlight and salt as a preservative. The salt used is mountain salt in large shapes and has no mixture.
2	*Intan* (Diamond)	Local stuff	Martapura is a diamond-producing area where there are many diamond panning places. Diamond is classified as a mineral with carbon, with a high hardness and luster. Diamonds are used to make jewelry.
3	*Tanggui* (Women's Head Scarf)	Local crafts	*Tanggui* is classified as a local craft in the form of a typical banjar hat that covers the head, so it does not get too hot. The materials used to make tanggui are *paikat* (rattan), *ulatung*, *nipa* leaves, and *bakul jajahan* (filter baskets).
4	*Tapai* Gambut	Food	*Tapai* Gambut is *tapai* made by Gambut community using fermentation: the oxidation reaction of organic compounds in glutinous rice and cassava with *tapai* yeast (*Saccharomyces cerevisiae*). The main content of these organic compounds is carbohydrates (starch or polysaccharides).

Iwak karing sepat (*sepat* dry fish) is food preserved by salting and drying techniques. The salting technique preserves the *sepat* fish by adding salt to the fish's body. This process is carried out on the principle of osmosis, in which salt can absorb water from the fish's body (Budiman, 2004; Usmany & Liline, 2018), thereby inhibiting the growth of spoilage bacteria. The salt used should also use pure NaCl salt and contain little $MgCl_2$, $CaCl_2$, $MgSO_4$, $CaSO_4$ (Budiman, 2004), and others because it will affect the quality of the *sepat* fish. Figure 2 shows *sepat* dried fish.

Figure 2. *Sepat* Dry Fish (Source: BUMN House)

Preservation techniques with salt can also increase the protein content in *sepat* fish (Puspitasari et al., 2021). Also, using salt to preserve fish can stabilize the protein so it does not dissolve in water. The low salt content can increase hydrogen bonds between water molecules that evaporate with low protein solubility (Wahyudi & Maharani, 2017). Preservation with salt can be maximized if it is continued with the drying process. The drying process can be done manually or in an oven under the hot sun to reduce the water content of the *sepat* fish.

The next discussion is about Martapura diamonds obtained from panning in the form of "*galuh*". Diamond is an allotrope of carbon with very hard properties and is in the form of crystals (Barokah, 2022). This tough structure is formed from covalent bonds of carbon atoms, which bind 4 other carbons to form a tetrahedral structure (Estiningrum, 2020). This condition makes diamonds different from other allotropes of carbon.

The next is *tanggui*. *Tanggui* (women's head scarf) hat is made of woven nipa leaves and is usually used by farmers when harvesting rice. The Nipah leaves are dried/sun-dried before being woven and shaped into a circle. The following shows a *tanggui* image in Figure 3.

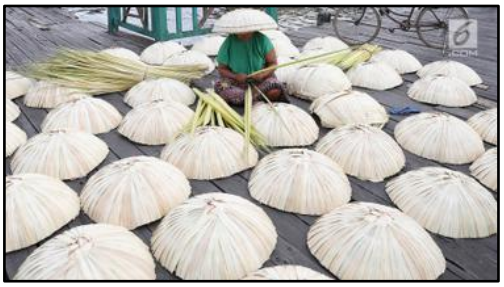

Figure 3. *Tanggui* Manufacturing Process (Source: Liputan6.com)

This plaiting process requires special expertise so that the formed Nipah leaves cannot be separated; it can form a strong bond. Usually, this weaving skill is passed down from generation to generation by *tanggui* craftsmen (Istika, 2022).

The next local wisdom is *tapai* Gambut, usually made from glutinous rice or cassava. The manufacturing process is the same as another *tapai*, fermentation with yeast. *Tapai* fermentation is a microbial metabolic process that converts cassava or glutinous rice starch into glucose (Sitorus & Toepak, 2022). The following is a chemical reaction that occurs in tapai fermentation.

$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2 + 2\ ATP$$

The results of *tapai* fermentation are alcohol and carbon dioxide. Moreover, the fermentation of *tapai* using yeast effectively converts glucose into ethanol through an anaerobic process (Dirayati et al., 2018).

3.1.3.Barito Kuala Regency

Barito Kuala Regency is directly adjacent to Kapuas Regency, Central Kalimantan Province, located by the sea. The following are the results of ethnochemical exploration and inventory in Banjar Regency in Table 3.

Table 3. Ethnochemical Exploration and Inventory Results in Barito Kuala Regency

No	Etnochemistry	Category	Description
1	*Laduman*	Local tradition	*Laduman* is a cannon war tradition usually carried out before Ramadhan or Eid. Laduman tradition usually uses carbide and thick bamboo sticks.
2	*Kelakai*	Local stuff	The *kelakai* plant is commonly used as a blood booster drug. Many compounds and minerals are contained in the plant, including calcium and iron.

Laduman traditional activities are carried out before the month of Ramadan. *Laduman* is usually made using bamboo filled with carbide and water so that it can explode. Carbide or calcium carbide (CaC_2) can be reacted with water (H_2O), which will form acetylene gas and calcium hydroxide (Mayhutomo et al., 2018) with the following reaction:

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

The acetylene gas formed is flammable, when a fire ignites it; it will produce a strong explosion.

The next local wisdom from Barito Kuala Regency is *kelakai* plant that is commonly used to increase blood. The high content of iron in molasses can be used to increase hemoglobin levels in the blood (Qamariah & Yanti, 2018; Ratnawati & Indrawati, 2019). *Kelakai* is a plant that can absorb iron from peat soil to reduce the soil's acid content and toxic elements. The following is the oxidation reaction of pyrite, which causes peat soil to be acidic (Ratnawati & Indrawati, 2019).

$$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 8SO_4^{2-} + 16H^+$$

When flooded, Fe^{3+} will be reduced to $Fe^{2+,}$ which the male can then absorb with the following reaction equation:

$$Fe(OH)_3 + 3H^+ + e^- \rightarrow Fe^{2+} + 3H_2O$$

3.1.4.Tanah Laut Regency

The next regency is Tanah Laut Regency, with Pelaihari as the capital. The results of ethnochemical exploration and inventory in Tanah Laut Regency in Table 4.

Table 4. Ethnochemical Exploration and Inventory Results in Tanah Laut Regency

No	Etnochemistry	Category	Description
1	Ironwood/*Kayu Ulin*	Local stuff	Ironwood is commonly used as a foundation material for Banjar houses because it is hard and resistant to temperature, humidity, water, and termites. Most of the Banjar land is a swamp, causing the Banjar houses to look like stilts supported by ironwood.
2	Ironwood Fruit Hair Oil (*Ulin* Fruit Hair Oil)	Drugs	The materials used are fruit, shoots, ironwood tree leaves, and coconut oil. This drug is useful for preventing hair loss, dandruff, and gray hair.

Ironwood or Borneo wood is a superior wood that is very strong, resistant to water and termites, and durable. The content of ironwood extract in the form of alkaloids, tannins, saponins, flavonoids, and polyphenols can be used as pesticides (Amaliyah et al., 2020) and inhibitors of the growth of various bacteria (Ajizah, 2007). In addition, ironwood powder (remaining material properties) can be used as briquettes which has advantages compared to coconut shell briquettes (Saukani, 2020).

Ironwood sawdust briquettes are used as fuel and are effective in refining used cooking oil using the adsorption method (Oko et al., 2020). The anti-inflammatory content is also in the Ulin fruit, useful as hair oil. This processed product can prevent hair loss and blacken hair (Sasmita et al., 2008). Iron fruit has potential antioxidant activity from the methanol extract of using leaves against free radicals (Aryani, 2021). The picture of ironwood is shown in Figure 4.

Figure 4. Ironwood or Borneo Wood (Source: Pinhome)

3.1.5.Tanah Bumbu Regency

Tanah Bumbu Regency has a fairly large area with various local pearls of wisdom in it. The result of ethnochemical exploration and inventory in Tanah Bumbu Regency is shown in Table 5.

Table 5. Ethnochemical Exploration and Inventory Results in Tanah Bumbu Regency

Etnochemistry	Category	Description
Fish *Pentol*	Food	Pentol fish is made from meat mixed with other ingredients such as starch and spices. Some of the ingredients in fish *pentol* are protein, carbohydrates, fat, sodium, and potassium.

The livelihoods of the Pagatan people in Tanah Bumbu district are fisherman. Fish catches are processed into fish sticks typical of Pagatan. Fish *pentol* is made from fish meat, flour, and spices which are processed together, then shaped. The addition of cold water to the *pentol* dough serves to make the dough emulsified and to keep the dough from drying out (Chakim, 2013). Some of the ingredients in the fish *pentol* are various proteins, carbohydrates, and fats (Ismail et al., 2016).

3.1.6.Kotabaru Regency

The location of Kotabaru Regency is separated from the mainland by South Kalimantan. To reach the district, the community must cross first by ship. The results of ethnochemical exploration and inventory in Kotabaru Regency are shown in Table 6.

Table 6. Ethnochemical Exploration and Inventory Results in Kotabaru Regency

No	Etnochemistry	Category	Description
1	*Abon Ikan Selangat*/ S*elangat* Shredded Fish	Food	It is similar to other shredded fish but differs in the main ingredient. The scorching fish used will be pressed to crush the bones. Then, the fish is crushed and seasoned, and then cooked for about 15-30 minutes.
2	*Sumur* Manggurak/ Manggurak Wells	Local tradition	Manggurak wells, or boiling wells, contain sulfur, which makes the wells hot. The water in the well can also be used to cure skin diseases.

The *selangat* fish is made into shredded fish to increase its selling value. In manufacturing, the fish cleaned in presto is then crushed with spices and fried in oil for 15-30 minutes. During the frying process, hydrolysis, oxidation, and polymerization reactions occur (Khoirunnisa et al., 2019). During the frying process, the hydrogen bonds between water molecules are broken, so the water evaporates quickly, accompanied by an increasing frying heat. The brown color produced by shredding results from a non-enzymatic browning reaction. The brown color is formed due to the reaction of reactive aldehydes and ketones with free amino acid groups (Dewi et al., 2011).

Manggurak wells or boiling wells can cure skin diseases because of their sulfur content. Sulfur, often found in nature, is in the form of sulfides and is commonly used to make sulfur soap (Pogoa & Tahril, 2021). The following is a picture of the Manggurak well in Figure 5.

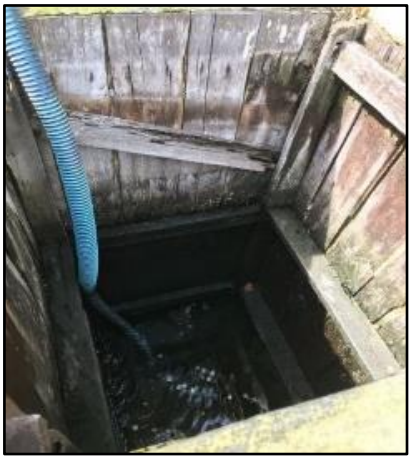

Figure 5. *Sumur Manggurak* in Kotabaru Regency (Source: Personal documentation)

3.1.7. Balangan Regency

Balangan Regency was a division regency from Hulu Sungai Utara in 2003. The following are the results of ethnochemical exploration and inventory in Balang Regency in Table 7.

Table 7. Ethnochemical Exploration and Inventory Results in Balangan Regency

Etnochemistry	Category	Description
Mandai	Food	*Mandai* is fermented from peeled jackfruit skin. Then, salt is added to preserve it and soaked in water for a few days. Mandai can be cooked stir-fried, fried, or in other ways.

Mandai is a typical Banjar food obtained from the fermentation of the inner cempedak skin. Fermentation is done by soaking the skin of the jackfruit in a high concentration of salt solution for two weeks. *Mandai* salting inhibits the growth of spoilage bacteria and causes a spontaneous fermentation process (Siregar et al., 2014). This process will produce organic acids, especially lactic acid, obtained from microbial activity (Rahmadi, 2019). The following is the *mandai* fermentation process in Figure 6.

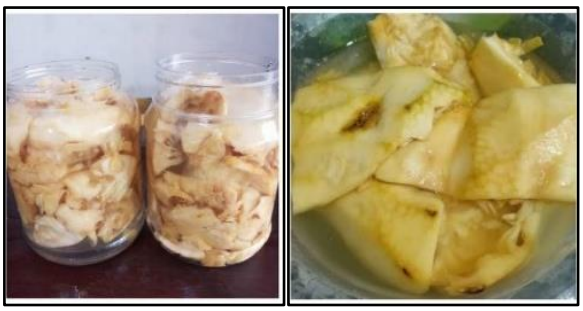

Figure 6. *Mandai* Fermentation Process (Source: Tabloid Sinar Tani)

3.1.8. Hulu Sungai Selatan Regency

Hulu Sungai Selatan Regency has a government center in Kandangan District. The results of ethnochemical exploration and inventory in Hulu Sungai Selatan Regency are in Table 8.

Table 8. Ethnochemical Exploration and Inventory Results in Hulu Sungai Selatan Regency

Etnochemistry	Category	Description
Lahang ice	Drink	*Lahang* ice comes from sap water obtained from palm trees, then packaged and frozen in the refrigerator.

Lahang ice is made from palm tree juice, the raw material for brown sugar. The sap water left for a long time will turn into vinegar and wine. This drink means sap water undergoes fermentation to form acids or alcohol. The carbohydrate content in the sap will be broken down into monosaccharides through a hydrolysis process (Sinaga et al., 2021), with the hydrolysis reaction process with the invertase enzyme as follows:

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6$ (glucose) + $C_6H_{12}O_6$ (fructose)

The fermentation process continues on the glucose formed, producing alcohol and carbon dioxide by following this reaction:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

If the fermentation process is not stopped, an oxidation reaction occurs to form carboxylic acids (Harmawan et al., 2019), with the reaction process as follows:

$$C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$$

This reaction usually occurs due to the activity of *Acetobacter sp*.

3.2. The Integration of Ethnochemistry as a Senior High School Chemistry Learning Resource

The results of the exploration and inventory of Banjar ethnochemistry in 8 regions in South Kalimantan can be integrated and used as a source of learning chemistry for senior high school context. Further analysis states that Banjar ethnochemistry can be utilized in green chemistry, periodic system of elements, chemical bonds, chemical reactions, hydrocarbons, thermochemistry, reaction rates, acids and bases, hydrolysis of salts, colloids, colligative solutions, redox reactions, elemental chemistry, alkane derivatives, and macromolecules. Further studies regarding integrating Banjar ethnochemistry as a source of chemistry learning can be seen in Table 9.

Table 9. Ethnochemistry Integration as a Source of Chemistry Learning

Class	Material	Concept	Etnochemistry
X	Green Chemistry in Sustainable Development 2030	Chemical environment	*Sasirangan* wastewater treatment
	Periodic System of Elements and Periodic Properties of Elements	Periodic System of Elements	a. Sulfur in the Manggurak wells b. Iron in *tanah rawa*/marshland c. Heavy metals in *sasirangan* wastewater
	Oxidation and reduction reactions	Oxidation reaction	*Tapai* Gambut fermentation
		Reduction reaction	Iron reduction reaction in marshland
	Chemical Bonds and Molecular Shapes	Chemical bond	*Tanggui*
		Ionic bond	Salt in the salting process of s*epat* fish
		Covalent bond	Bonds to diamonds
		Hydrogen bond	Salting process of *sepat* fish; frying process of *selangat* shredded fish
		Molecular shape	The shape of the diamond molecule
	Chemical reaction	Chemical reaction	The reaction of carbide with water in *laduman*

Table 9. Ethnochemistry Integration as a Source of Chemistry Learning

Class	Material	Concept	Etnochemistry
XI	Hydrocarbons	Carbon	a. Diamond maker b. Active charcoal constituent in rubbing ash and ironwood powder
		Alkyne	Acetylene gas in *laduman*
	Thermochemistry	System and environment	*Batimung* process
	Reaction rate	Reaction rate factor	Carbide concentration and surface area
	Acid-Base	Acid	*Mandai*-fermented organic acids
		Base	The reaction result of lime water on *laduman*
	Salt Hydrolysis	Salt	Salt in the salting process of s*epat* fish
	Colloid	Colloid type	Fish *pentol* dough in the form of an emulsion
		Coagulation	*Sasirangan* liquid waste coagulation process
		Adsorption	a. Activated charcoal on rubbing ash b. A plant that absorbs iron c. Purification of used cooking oil with activated ironwood charcoal
	Colligative Properties of Solutions	Osmotic pressure	Osmotic pressure in *basungu* process
	Redox Reaction Balancing	Redox under acidic conditions	Pyrite oxidation reaction on peatland acidification
	Elemental Chemistry	Metal element	a. Heavy metals in *sasirangan* wastewater b. Iron contained in *kelakai* plant c. Sulfur content in the Manggurak well
XII	Alkane Derivative Compounds	Alcohols and carboxylic acids	The fermentation process of *tapai* Gambut, *lahang* ice, and m*andai*
		Aldehydes and ketones	Non-enzymatic browning reaction in the production of *selangat* shredded fish
	Benzene and Its Derivatives	Phenol	Flavonoid compounds in Banjar soup spices, polyphenols in ironwood and ironwood fruit
	Macromolecules	Carbohydrates, proteins, fats, amino acids	The nutritional content of Banjar soup, fish *pentol, sepat* dry fish, *tapai* Gambut, and *selangat* shredded fish.

The results of the analysis on the integration of Banjar ethnochemistry can be utilized by educators and students alike. For educators, chemistry learning resources can be developed by utilizing ethnochemistry to conduct the learning process more contextually. However, using ethnochemistry in chemistry learning has proven effective in increasing students' understanding (Jofrishal & Seprianto, 2020) and achieving meaningful learning (Arif et al., 2021). In addition, cultural preservation in the Banjar area will be maintained (Azizah & Premono, 2021).

4. Conclusion

Results of the exploration and inventory of Banjar ethnochemistry in 8 areas: Banjar soup, *sasirangan*, *basungu*, rub ash, *batimung, sepat* dry fish, diamond, *tanggui*, *tapai* Gambut*, laduman, kelakai,* ironwood, ironwood hair oil, fish *pentol*, *selangat* shredded fish, Mangurak wells, *mandai,* and *lahang* ice. Besides, Banjar ethnochemistry can be used in green chemistry, periodic system of elements, chemical bonding, chemical reactions, hydrocarbons, thermochemistry, reaction rates, acids and bases, hydrolysis of salts, colloids, colligative solutions, redox reactions, elemental chemistry, alkane derivatives, and macromolecules.

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