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Analysis of Relevancy of Local Culture Wisdom in Salt Production with Analytical Chemistry Subject in Order to Develop Instruments for Integrated Etnochemistry Lecture

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Abstract: This descriptive research aims to analyse the relevance of local culture wisdom with Analytical Chemistry subject which is integrated with etnochemistry in production of salt in order to develop learning instruments based on Problem Based Learning (PBL) learning method. The objects of the research are local culture wisdom in production of table salt (in Pijot village, Sub-district of Keruak, Distric of East Lombok, West Nusa Tenggara Province, Indonesia) and Analytical Chemistry subject. Data is collected from documents and interview and then being analysed descriptively. The results showed that (1) There is a relevancy of local culture wisdom element in production of salt with any topic in Analytical Chemistry subject, (2) Lecture instruments of Analytical Chemistry subject which is integrated with etnochemistry could be developed by including sea water, salt, and bittern water as learning media in class lecture and in practical work in laboratory, and salt crystallization process as learning source, (3) Lecture instruments of Analytical Chemistry subject which is integrated with etnochemistry based on PBL method could be developed by including real problem in society as a way to improve quality of salt so it appropriate with SNI standard. (SNI = Standar Nasional Indonesia: Indonesia National Standard).

Keywords: Etnochemistry; Etnochemistry of Salt Production; Local Culture Wisdom.

Introduction

One of some factors of the lessen of local culture wisdom values in Indonesia is the fast of increasing of globalization (Puspasari A 2019). Science learning demand in curriculum 2013 is an appropriation between the subject learn**ed** and experience or existing examples in daily life (Nahdiah and Hamid 2017). Students of Chemistry Study Program, The Faculty of Teacher Training and Education, Mataram University as candidates of teachers need to grab experience in learning process that is integrated with culture, because science learning will be better to be comprehended by students if teacher gives attention to local culture. This is in accordance with (Baker and Taylor 1995), if science learning does not give attention to culture, so the students only receive a part of science concepts which is developed in school without application knowledge in society.

In science, learning approach with culture as object is called with etnoscience (Shidiq 2016) so refers to that terminology, etnochemistry is a study of chemistry from local wisdom view which contributes in knowledge about matter and its changing (Sudarmin and Sumarni 2018; Winarti 2018) Characteristic of chemistry learning which is integrated with etnochemistry is practisized by including local culture elements into chemistry learning, start from learning sources, learning method that is able to combine local culture with chemistry concepts which they are learned, and also some learning media which are indirectly could unify local wisdom science with chemistry subject which is learned in school (Sumarni 2018). Chemistry learning which is thought with integrated chemistry concepts with local culture could be started with observation from real world context in society and then bind with molecule and symbolyc

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representations to describe that chemistry phenomenon (Eskrootchi & Oskrochi, 2010; Parchmann, 2015).

The competence of Analytical Chemistry lecture is to learn about what and how much the substance composition in a matter, so integration of local wisdom in Analytical Chemistry lecture is a very strong need. By integration of material or process which is received from local culture activities in surrounding, it gives context and content as starting knowledge in application of chemistry. Refers to Aji (2017), that success of learning process is affected by culture back ground of students or society where school exists and this could increase strong liking toward their potential of local culture and this also could increase their willingness to conserve (Suardana 2010). This accords with conclusion of (Atmojo 2012) in his research that using of PBL-BE learning model is able to bridge students' culture and science culture. As a consequence, students will be more interest, more enthusiastic and more fun in learning.

West Nusa Tenggara Province (NTB) owns some salt sites such in West Lombok, Central Lombok, East Lombok, Sumbawa and Bima districts (Subhan 2019). Salt farmers in NTB, generally, still apply traditional ways in salt processing which they brought from their hereditary based on local wisdom of former society. However, this contrary with observation result of students who are taking Analytical Chemistry lecture whose 80% of them stated do not understand or do not know the availability of local salt and the way to produce it. This reality supports the importance of integration of local culture in salt production in Analytical Chemistry lecture.

Local culture element in salt processing that relevant with Analytical Chemistry learning material needs to be integrated in lecture with PBL model to give a chance to students to find out solution to overcome problem they found through investigation or science review. PBL is a learning model where students are the center of learning which is pushed by existing of real problem, not by abstract concepts (Hmelo-Silver, C. E., & Barrows 2006).

To conduct PBL lecture that is integrated with etnochemistry effectively and efficiently need to prepare supporting learning instruments. Salt production is a kind of local culture which is going to be studied whether it has relevancy with science knowledges which are needed in Analytical Chemistry learning material. This research aims to analyze the relevancy of local culture in local salt processing in Pijot village, Keruak sub-district, East Lombok district with learning material of Analytical Chemistry lecture in order to develop lecturing instruments of integrated PBL etnochemistry

Method

This study is a descriptive research. The subject or data sources are documents (journals and sbooks) and information from salt farmers in Pijot village. The object of the research is study on relevancy of salt processing with Analytical Chemistry learning material which is integrated with PBL model.

Research instruments used to collect data are interview guidance to inventory production process of salt and form sheets to inventory documents. Collected data then be analysed descriptively regarding to reveal the relevancy of local culture salt production with learning material of Analytical Chemistry lecture. Study on relevancy can be viewed from raw material, processing, product, and purpose in culture local salt production.

Result and Discussion

Processing of Salt Production

Based on the results of observation, interview, and documentation in Pijot village, it is found the data of production processing of krosok (rough) salt and fine salt. Salt production processing is started by preparing to construct a space like field rice with dense soil, plated and be cascaded by seawater simultaneously. This aims to cover soil pores so the soil become tied up. Then, seawater is flowed and collected in that constructed plate space. Collected water then irradiated by sunshine (solar energy) in order to vapor water so it gives crystal salt granules. After ten to fifteen days, crystal salt can be harvested. The salt produced apparent two kinds of salt that is the salt on the upper layer looks white and the ones that still mix with soil it is called with black salt or impure salt. The last salt, then continue to be cooked. After cooking it gives fine, clean and clear salt. Beside the two kinds of salts, farmers also gain water bittern and this product is sold to tofu industry which functions as a coagulant. From interview also found information that local salt produced only for consumption of local people; can not be sold as industry salt. This raise a problem for salt farmers because at the harvest time, salt will be mounted and as a consequence, the price go down.

Chemistry Study in Salt Production

Scientifically study for salt production from science knowledge is a base in salt production processing started by chemical and physical properties. Seawater as a raw material for production of salt contains too many chemical elements such as water 90% and minerals 10%. Minerals in seawater consist of 55% Cl, 30% Na, 5% sulphur, 3% Mg, 1.5% potassium and 2% micro minerals (Geertman, 2000). In irradiation step of seawater with sunshine, there happens an evaporation process. This process is a separation or reduction of water with the aim to condense seawater et al, 2014).

To produce salt, it needs an adjustment of concentrate seawater till 25 – 29^{0}Baume (^{0}Be) so it reach maximum concentration of NaCl. The Be degree (^{0}Be) is a scale is used in hydrometer device which function to

measure or to determine density of a liquid. (Woody 2000) Crystallization is a formation process of precipitated particles that happens in saturated solution or in over saturated solution. Saturated solution is a solution with highest concentration. Forming of crystal is affected by rate of nucleation and degree of saturation of solution. Growing of the size of crystal through two steps; primary and seconder nucleation (R.A. DAY, JR 1992). Primary nucleation or forming of crystal nuclei is the step where the crystals start to grow, but it is not precipitate yet; much more nuclei join together, faster the growing of crystals. The next step is seconder nucleation that is adhering of crystals nuclei become solid crystals so the crystals would grow getting bigger.

Crystals salt are formed if the concentration of seawater reach 25 – 29^{0}Be. During irradiation, seawater will concentrate steeply as well as the other compounds, but iron oxides and calcium carbonates contained in seawater will be crystalized first, followed by calcium sulphates. At the meanwhile, sodium chloride will be crystalized if 75% of seawater reach over saturated concentration that is if seawater has vapored as much as 97% ; at this time, sodium bromide also begins to crystallized and mix with sodium chloride. Phenomenon of crystallization steps during irradiation of seawater appropriate with data of solubility in Svehla, (1997) that order of solubility values of each compound are as follows Fe_2O_3 < $CaCO_3$ < $CaSO_4$ < NaBr < NaCl < $MgSO_4$ < $MgCl_2$. Smaller the value of solubility of a compound, easier formation of precipitate or crystal. Iron oxide compound has lowest solubility value, so it will precipitate first and followed by $CaCO_3$, $CaSO_4$, NaBr and NaCl. If there is no special separation process during irradiation process will affect on purity or quality of salt.

Table salt composed of Na and Cl ions, white crystal form with isomeric system cubic form (Arief 1984). Composition of salt consist of 80% NaCl (Marihati & Muryati 2008) and other compounds that are classified as impurity such as iron oxide (Fe_2O_3), chalk ($CaCO_3$), calcium sulphate ($CaSO_4$), magnesium sulphate ($MgSO_4$), magnesium chloride ($MgCl_2$), and potassium chloride (KCl) (Efendy, et al, 2012). According to Geertman (2000), salt contains chlor about 55.5%, sodium 30.8%, sulphate 7.7%, mahnesium 3.7%, calcium 1.2% and potassium 1.1%.

Salt quality can be seen from salt apparently both physically and chemically. A good salt is showed by fine crystal form and shows clear white. Chemically, quality of salt is determined by concentration of NaCl that contained in salt. Based on SNI 01-3556-2000, minimum concentration of NaCl in consumption salt is 94.7%. People process black salt so can be consumed and has high economically value which is affected by the way of filtering and cooking. Filtering aims to separate soil from salt and cooking or boiling aims to crystalize salt (recrystallization).

Recrystallization is a way to purify chemical substance (Laurence, et al 1989). According to Rositawati (2013) definition of crystallization is purifying of a substance from its mixture or from its impurities by the way recrystallization the substance after dissolved in an appropriate solvent. By redissolution of salt so impurities and compounds in appropriate solvent, either wanted compounds or impurities can be discharged from its salt. Crystal quality can be determined by distribution of crystal size, crystal purity and crystal shape.

After salt crystalized there is still rest of water which is not crystalized that is called with old water or bittern (Hadi and Ahied 2017) that has bitter taste and contains salts of magnesium, potassium, sulphate and chloride (Purbani 2000). If it is viewed from its solubility value, solubility of NaCl is 358.6 gr.L^{-1}, $MgCl_2$ is 558.1 gr.L^{-1}. These show a very high different solubility so the cooking time can be conditioned in order to avoid crystallization $MgCl_2$ so the taste is not bitter anymore. This case can be applied also in adjustment the age or duration of harvest time so $MgCl_2$ does not include in crystallization and this can increase quality of salt (Purbani 2000).

The rest of water which does not crystalized can be used as coagulant in making of tofu. Many tofu industry in Lombok use this water because it can gives more tasty tofu. This accords to the result of research conducted by Rahayu, (2014) which explains that as coagulant, bittern contains very high minerals and can give better tofu.

Coagulation principle for salt is to precipitate protein through salting out process that is adding of excess salt in protein solution that cause water molecules attracted to salt ions so it could reduce the amount of water molecules which are interacted with protein. Decrease of amount of water molecules which are bonded to protein cause attractive force among proteins becomes stronger so protein may precipitate and form curd (Winarno 2008).

Relevancy of Culture Element in Salt Production with Study of Analytical Chemistry

Exploration of the relevancy of salt production with study of Analytical Chemistry on competence Analytical Chemistry lecture conducted by analyzing raw material, product or order of moment in salt production process. Raw material for production of salt is seawater and the products are clean salt, black salt or dirty salt, and the rest of water which can be integrated with learning media that will be studied their chemical composition. The order of moment in salt production and phenomenon of formation of crystal can be integrated with learning material. Table 1 below gives the results of exploration on general knowledge about salt and its production process.

Table 1. Relevancy of Salt Production with Analytical Chemistry Learning Material

Analytical Chemistry Learning Material	Relevancy of Salt Production with Analytical Chemistry Study
Quantitative Analysis Identification reaction and separation of group I, II, III, IV, and V cations use precipitation method. Identification of anions of group sulphate, carbonate, and halogen	Seawater, white salt, dirty salt, and bittern water contain some cations and anions in different concentration that can be used as learning material which connect with: a. Grouping of macro and micro elements in seawater, salt, and rest of water from salt crystallization (bittern) b. Identification of cations and anions as composer substance with precipitation reaction and cation flame test c. Designing of cations and anions separation schema contained in seawater, salt and bittern water based on the value of solubility (*K*sp) d. Designing of the way to increase purity of salt by separation of impurities such as $CaSO_4$, $MgSO_4$ dan $MgCl_2$ Designing and laboratory work To identify existing of cations and anions in seawater, clean salt, dirty salt, fine salt and bittern a. To remove impurities such as $CaSO_4$, $MgSO_4$ dan $MgCl_2$ contained in salt
Concentration unity Molarity, Normality, density and mass % :	Based on the data from reference study about contents and composition of composer in seawater, salt and bittern that can be used for: a. To explain concentration of substance in solution and solid samples (seawater, salt, and water bittern) that can be used to predict which salt can be produced b. To explain Be unity (^{0}Be) and its relation with degree of saturation/solidity/density of seawater that roles in salt crytalization process c. To explain the purity or quality of salt which refers to SNI
Gravimetric Analysis: Basic concept of gravimetric analysis Precipitate process mechanism/crystal, growing of crystal and factors that affect coprecipitation and postprecipitation	a. In salt crystallization process there happens precipitation process steeply from Fe_2O_3, $CaCO_3$, $CaSO_4$,NaCl, $MgCl_2$ $_t$that connect with their solubility and Be degree values b. Crystal salt formation and growing c. Factors that affect crystal growing d. Availability strange substance in salt crystal due to coprecipitation, oclusi and adsorption and postprecipitation that affect on purity of salt crystal a. Data on concentration of Na and Cl in seawater connect with the way to predict mass of product resulted and how much seawater is needed Designing and laboratory work Measurement of water concentration in local salt and in fine salt in order to find out the quality of salt a. Measurement concentration of NaCl in seawater, local salt, dirty salt, and fine salt in order to find out the quality of seawater and salt b. Measurement concentration of Mg in bittern water
Volumetric Analysis Basic concept of volumetric analysis, acid-base titration, precipitation titration, redox titration, and complexing titration.	Designing and laboratory work due to: Measurement of NaCl concentration in seawater and in local salt with precipitation titration a. Measurement of Mg in water bittern with complexing titration b. Measurement of Ca in water bittern with redox titration

Table 1 above shows there is culture element in salt production such as seawater, salt and water bittern as learning and practical work media that relevance with several topics such as qualitative analysis, gravimetric analysis, concentration unit, and volumetric analysis. Steeply salt crystallization process during drying and purifying shows a relevancy with gravimetric analysis topic.

Information is also gained from salt farmers problems that in the harvest time, salt might be mountain so the price would be low because the produced salt only consumed by surrounding people and could not be sold to industry as "industry salt". Until now on, all salt farmers do not have knowledge about their produced salt quality whether the salt accords to industry salt or not at all so the problems are not be answered yet.

Problem which is gained in that salt field is a real problem that support to develop Analytical lecture instruments based on PBL that integrated with etnochemistry. Analytical Chemistry lecture try to find the answer especially for the local salt quality in Pijot village. To find the quality of that salt can be studied from physical property of salt, water content and purity which refers to SNI. Students will be directed to exercise in finding solution over problem through literature study, discussion to design and to do practical work in order to gain accurate data due to find the root of problem, to design solution, and to determine next steps so local salt owns SNI quality and owns high price.

Conclusion

Based on the results of this research and on discussion above, it can be concluded that: (1) There is a relevancy of local culture in salt production with Analytical Chemistry lecture, (2) Analytical Chemistry lecture instruments that is integrated with etnochemistry can be developed by including seawater, water bittern and crystallization process as learning media, learning source and practical work media, (3) Analytical Chemistry lecture instruments which is integrated with etnochemistry based on PBL can be developed by including real problem that is found on the salt farmers.

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Conceptualization, M; methodology, A., Y., ; validation, S; formal analysis, M., and I.,; investigation, M, S; resources, E., I., R.N.R. ; data curation, S., E., I., R.N.R.; writing-original draft preparation, M. and S. ; writing-review and editing, I. and E.; visualization, S., I.; supervision, S., and E. ; project administration, M, S., J., A., Y., H., M.,; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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