Nepal Export Project: The Exportation of Cheese Starter Cultures for the use of Fermenting Milk into Cheese

Lukas DeVos

AGR 1110

University of Guelph

Introduction into Agrifood Systems

Introduction to Nepal:

Nepal is an undeveloped, food deficit country which means that much of the population does not get enough food (Pyakuryal, Roy, & Thapa, 2010). The Nepalese population is generally lacking in vitamin A, calcium, and protein, as well as other nutrients suggesting marginal malnutrition to be present in children under 5 years of age (Brown, Worth, & Shah, 1968). Nepal has a very low per capita income, and much of the population relies on agriculture as their primary form of income (Pyakuryal et al., 2010). The steady growth of tourism is beneficial towards the economy of Nepal, with the majority of the Nepalese tourist population interested in adventure (Zurick, 1992).

Introduction to Cheese Starter Cultures:

The production of cheese is dependent on the presence of bacteria in milk in order to ferment the raw product (Leroy & De Vuyst, 2004). Early production of cheese occurred due to an uncontrolled presence of this bacteria and this natural process is called spontaneous fermentation (Leroy & De Vuyst, 2004). In order to make the process more controllable, as well as less time consuming, the milk can be inoculated with starter cultures, to start the growth of bacteria, as well as rennet to begin the coagulation of the raw milk (Leroy & De Vuyst, 2004). Fermented dairy products are typically less perishable then raw milk, and as a result can last much longer without spoiling (Cleveland, Montville, Nes, & Chikindas, 2001). Since fermented

products are less perishable then the raw produce it originates from, the fermentation of milk can be a very useful method to preserve raw dairy produce.

Modern Production of Cheese:

The manufacture of cheese consists of heating raw milk to between 30 °C and 35°C and then inoculating the milk with starter cultures (Fox, McSweeney, Cogan, & Guinee, 2004). Rennet is added to assist in the coagulation of milk to form curd, and the curd is then separated by draining the whey from the curd (Fox et al., 2004). The curds are then pressed into solid blocks to form cheese, and cooled and periodically inverted to continue the ripening of the cheese until the product is ready to be consumed (Fox et al., 2004).

Production of Starter Cultures and Rennet:

Cheese starter cultures can be produced by inoculating a fermentation chamber with the bacteria cultures, and maintaining the pH at a constant, optimal level in which is dependent on the type of culture (Høier et al., 2010). The fermentation of the cultures allows for the propagation of new cultures, and therefore, producing more of the bacteria. (Høier et al., 2010). After the bacteria is fermented, the bacteria started cultures can be extracted through the use of a centrifuge or by means of membrane filtration, effectively concentrating the solution of bacteria cells (Høier et al., 2010). Using liquid nitrogen, the bacterium concentrate is freeze dried and packaged in an inert gas so that the culture can remain living for up to 24 months (Høier et al., 2010).

Rennet is an enzyme present in calf stomachs that can also be obtained through the fermentation of plant based media to obtain the milk coagulation component, as well as other enzymes that have a negative impact on the cheese making process (Sternberg, 1977). The damaging enzymes are removed and the purified microbial rennet is packaged for use as a milk coagulant (Sternberg, 1977).

Nutritional Information:

Cheese is a highly nutritious form of milk that is very energy-rich as a result of the high content of fat and protein (Walther, Schmid, Sieber, & Wehrmüller, 2008). Cheese contains many of the nutrients essential to human life, including various amino acids, fatty acids along with other vitamins and minerals (Walther et al., 2008). The human body can greatly benefit from a diet including cheese as it is helpful in the growth and development of the body (Walther et al., 2008). To continue, the strength of bones and teeth can be strengthened as a result of the high calcium concentration contained in cheese and other dairy products (Dokkum et al., 2007; Ilich & Kerstetter, 2000; Walther et al., 2008). Cheese could serve as a very beneficial and rich food, containing vital nutrients and serving as a source of energy.

Product Introduction:

The intended product for exportation to Nepal is the Swiss Mountain cheese kit made by Danlac Canada ("Swiss Mountain Cheese kit using calf rennet powder | Danlac Canada Inc.," n.d.). This product includes the starter cultures, rennet powder and a recipe which includes directions making cheese ("Swiss Mountain Cheese kit using calf rennet powder | Danlac Canada Inc.," n.d.). The included rennet powder is capable of coagulating up to 5000 litres of

milk, however, the kit is limited by the amount of starter cultures included, and as a result can treat up to 1000 litres of milk at a cost of $46.50 (“Danlac Canada Inc. | Serving the Food Industry,” n.d.). This shows that milk can be treated for as low as 5 cents per litre. This cost is disregarding the idea that there will be rennet powder remaining following the use of all the starter cultures. To cut this cost, the starter cultures can be bought individually at a price of $15.00 (“Danlac Canada Inc. | Serving the Food Industry,” n.d.). This effectively cuts the cost to about 2.1 cents per litre, when 5000 litres is treated using the initial kit, as well as four additional containers of starter cultures. As a result of this, the cheese making supplies could be packaged together at a combined cost of $106.50 for shipment to Nepal to cut overall shipping costs, or the components can be shipped as needed to allow for smaller payments from the Nepalese producer.

Resources Required to Produce Cheese:

The process of making cheese requires various resources such as milk as well as heat (Høier et al., 2010). The production of milk is dependent on the intake of feed by the lactating animal to digest protein and energy from the feed and to convert the feeds nutrients into milk (Reid, Moe, & Tyrrell, 1966). Also, in order to make cheese, milk must be heated (Høier et al., 2010). The raw milk can be heated by using a wood fire in order to create optimal temperatures for cheese production (Aworh & Egounlety, 2009). As a result of the fire being used, wood will be required to produce and maintain a fire.

The Main resources that are required to process raw milk into cheese in an undeveloped location will include lactating animals, the feed required to feed the animals, the milk

produced, as well as wood to be used to heat the milk to ideal temperatures for the bacteria culture activity.

Equipment Required to Produce Cheese:

The production of cheese in undeveloped areas can be done by warming milk in a bucket by using the distant heat of flames and the whey can be separated through a wicker basket, leaving the curds which can then be salted and shaped by hand or pressed into a mould using weights (Fox et al., 2004). To monitor the temperature of the milk, a thermometer can be used (Scott, Robinson, & Wilbey, 1998). Since cheese can be produced affectively using this simple equipment, there is no need for specialized materials. All that is required is a bucket that is tolerant to moderate heat, a thermometer, as well as possibly a wicker basket and a mould with weights.

Ultimately, cheese can be made with simple equipment, creating ease in the initial production of cheese, allowing the Nepalese to use cheese starter cultures without large startup costs.

Market Opportunity in Nepal:

Starter cultures for the use of cheese fermentation can be targeted towards dairy farmers in Nepal. Starter cultures assist in the fermentation of milk into cheese, preserving the product so that it can last longer (Cleveland et al., 2001; Farkye, 2004). This product could benefit someone who possibly lives in a remote area, with little access to a market place. The

exportation of cheese cultures could allow rural Nepalese dairy farmers to ferment their produce in order to preserve their resource until they can transport it to a community in which they could sell the product. Also, cheese serves as a delight to tourists when visiting other countries (Bessiere, 1998). As a result of this, tourists of Nepal may enjoy the presence of cheese in the country. Starter cultures can benefit Nepalese farmers because of the ability to ferment cattle milk, as well as the milk from water buffalo and yak to produce cheese (Coppola, Villani, Coppola, & Parente, 1990; Dong, Long, & Kang, 2003). Since starter cultures can be used with buffalo and yak milk to make cheese, the Nepalese can market this cheese as a product that tourists would be attracted to because of its lack of normality.

The product can be marketed to Nepalese dairy farmers, not only who milking cows, but also farmers who milk yak or water-buffalo, to assist in the preservation of their produce, as well as to produce a product which will gain the interest of high paying tourists. Cheese starter cultures can be marketed to all Dairy farmers as a product that will benefit both the wellbeing and nutrition of Nepalese peoples as well as provide a source of income towards the dairy industry in Nepal through tourism.

Transportation:

Cheese cultures are relatively stable and can remain living without the need for refrigeration, given that they are not exposed to temperatures above 35°C (Ananta, Volkert, & Knorr, 2005). Also, the freeze dried cultures can survive for about 24 months (Høier et al., 2010). This is representative towards the ability to transport the bacteria cultures without having to satisfy special conditions. The starter cultures can be shipped using standard shipping. This product would be best shipped individually to maintain consistency in the product and to maintain freshness for the user in Nepal. Because only a few

packages will be transported at a time, the simplest method of the shipment of these cultures would through the use of an international courier service. This shipment would cost about $147.44 (“A1 Freight Forwarding,” n.d.). This quote is the approximation of the door-to-door shipment of the cheese making kit, as well as four additional cheese starter packages, with a cost of $106.50 for the product. (“Danlac Canada Inc. | Serving the Food Industry,” n.d.). This brings the cost of the product up to around $253.94 for the consumer in Nepal. This increases the cost of starter cultures and rennet for the use of producing cheese to about 5.1 cents per litre of milk treated.

The packaged product including starter cultures and rennet powder for treating up to 5000 litres of milk will cost the Nepalese dairy farmers about $253.94 to purchase their product and have a courier service take the product directly to Nepal.

Concerns Regarding the Production of Cheese in Nepal:

The production of cheese can be very labour intensive, and also requires being stored in a cool environment. To begin, Cheese production requires the milk to be warmed and this can be done by using a fire (Fox et al., 2004). Since fire can be used to warm the raw dairy produce, wood will be required in the production of cheese, meaning that the production of cheese requires the collection of wood to keep the milk at a warm temperature. Also cheese must be stored in a cool environment for ripening unless it is to be consumed immediately (Fox et al., 2004). This could be an issue for a farmer who does not have space for the storage of cheese in fairly cool environment. Also, cheese must be periodically turned over to aid in the ripening process (Fox et al., 2004) meaning that labour is also required to flip cheese periodically.

The production of cheese in Nepal can prove difficult due to the extra labour that would be required from the Nepalese consumer, as well as the refrigeration issues regarding the ripening of the

product. This could impact the success of exporting cheese cultures to Nepal since the conditions required to use the product effectively may not be easily met.

Cost Analysis:

Cheese cultures can be used in Nepal to treat milk at a cost of 5.1 cents per liter. For every 100 kilograms of milk treated, on average about 9.5 kilograms of cheese can be produced (Barbano & Sherbon, 1984). Since one kilogram of milk is approximately equal to one litre of milk (J. DeVos, personal communication, November 29, 2015), it takes about 10.5 litres of raw milk to produce a single kilogram of cheese. This shows that for every kilogram of cheese that is produced, about 54 cents worth of the starter cultures and rennet will be used, therefore costing the Nepalese producer 54 cents per kilogram of cheese. This cost is before the addition of the price of milk, as well as the labour which is necessary for the production of cheese. Once these costs are added up, it can be expected that the average Nepalese consumer will not reasonably be able to purchase cheese as a result of the low per capita income throughout Nepal (Pyakuryal et al., 2010). Although, the public may not be able to purchase the cheese made by the starter cultures, tourists may still be interested in the cheese, and may possibly be able to support a market for cheese in Nepal, and as a result, making cheese starter cultures a useful product for Nepalese dairy farmers.

Benefits to Nepal:

Cheese starter cultures can be a beneficial product to Nepal for several reasons. Firstly, Nepal is in a food deficit meaning that they do not have enough food (Pyakuryal et al., 2010). As a result of this processes which minimize the amount of waste or spoilage of raw produce could be appreciated. Raw produce is generally quite perishable, while fermented foods are typically much less perishable

(Cleveland et al., 2001). Using starter cultures and rennet to ferment milk into cheese (Leroy & De Vuyst, 2004) can effectively cut waste by stabilizing the dairy produce so that it can last much longer, thus limiting waste due to spoilage (Cleveland et al., 2001). Secondly, Cheese is very rich in energy and various other nutrients that are important to humans (Walther et al., 2008). This can be important to Nepal because of the presence of malnutrition amongst some of the Nepalese population (Brown et al., 1968). To Continue, tourists frequently enjoy experimenting with cheese from different locations (Bessiere, 1998). Cheese cultures can benefit the economy in Nepal through the sale of cheese to tourists visiting Nepal, especially since starter cultures can treat yak milk and water buffalo milk, as well as cow milk (Bessiere, 1998; Dong et al., 2003). This can be especially attractive to tourists because many of the people visiting Nepal are doing so for adventurous reasons (Zurick, 1992). Finally, the primary byproduct of cheese production, cheese whey can be utilized (Siso, 1996). Cheese whey can be fed in liquid form to farm animals as it contains proteins, lactose and various other minerals such as calcium (Siso, 1996).

The use of cheese cultures and rennet in Nepal to make cheese can be beneficial for the preservation of dairy produce, the nutrition of the Nepalese population, the sale of dairy produce to tourists, and the nutrition of farm animals through the nutrients found in the whey leftover from the cheese making process.

Conclusion:

The exportation of a cheese making kit including bacteria starter cultures and rennet powder can benefit Nepal through the preservation of raw dairy produce, the nutritional benefits of cheese to the population, the marketing potential of cheese to tourists of Nepal, as well as the use of cheese whey to provide nutrition to animals. this paper analyzes the export potential of a cheese making kit from Canada to Nepal as well as usability of the product in Nepal. The cheese making kit manufactured by

Danlac Canada out of Calgary, Alberta was investigated to determine the nutritional benefits, the required resources for use, the market in Nepal, the benefits as well as concerns regarding the Nepalese with the potential use of this product. This examination includes the cost of utilizing this technology in Nepal, including the cost of shipment of the Cheese making kits to the Nepalese dairy producers. Future studies are required in the actual cheese yields per litre of milk in Nepal to better determine the feasibility of this product in Nepal and the costs regarding the production of cheese.

To Conclude, Exportation of Cheese starter cultures from Canada to Nepal can prove beneficial to both countries under further investigation.

Word Count: 2804

References

A1 Freight Forwarding. (n.d.). Retrieved December 1, 2015, from http://www.a1freightforwarding.com/quote/bookingcourier.php

Ananta, E., Volkert, M., & Knorr, D. (2005). Cellular injuries and storage stability of spray-dried Lactobacillus rhamnosus GG. *International Dairy Journal*, *15*(4), 399–409. http://doi.org/10.1016/j.idairyj.2004.08.004

Aworh, O. C., & Egounlety, M. (2009). Preservation of West African soft cheese by chemical treatment. *Journal of Dairy Research*, *52*(01), 189. http://doi.org/10.1017/S0022029900024018

Barbano, D. M., & Sherbon, J. W. (1984). Cheddar Cheese Yields in New York. *Journal of Dairy Science*, *67*(8), 1873–1883. http://doi.org/10.3168/jds.S0022-0302(84)81517-9

Bessiere, J. (1998). Local Development and Heritage: Traditional Food and Cuisine as Tourist Attractions in Rural Areas. *Sociologia Ruralis*, *38*(1), 21–34. http://doi.org/10.1111/1467-9523.00061

Brown, M. L., Worth, R. M., & Shah, N. K. (1968). Health Survey of Nepal: Diet and Nutritional Status of the Nepalese People,. *Am J Clin Nutr*, *21*(8), 875–881. Retrieved from http://ajcn.nutrition.org/content/21/8/875.short

Cleveland, J., Montville, T. J., Nes, I. F., & Chikindas, M. L. (2001). Bacteriocins: safe, natural antimicrobials for food preservation. *International Journal of Food Microbiology*, *71*(1), 1–20. http://doi.org/10.1016/S0168-1605(01)00560-8

Coppola, S., Villani, F., Coppola, R., & Parente, E. (1990). Comparison of different starter systems for water-buffalo Mozzarella cheese manufacture. *Le Lait*, *70*(5-6), 411–423. http://doi.org/10.1051/lait:19905-631

Danlac Canada Inc. | Serving the Food Industry. (n.d.). Retrieved December 1, 2015, from http://www.danlac.com/

Dokkum, W. Van, De La Guéronnière, V., Schaafsma, G., Bouley, C., Luten, J., & Latgé, C. (2007). Bioavailability of calcium of fresh cheeses, enteral food and mineral water. A study with stable calcium isotopes in young adult women. *British Journal of Nutrition*, *75*(06), 893. http://doi.org/10.1079/BJN19960195

Dong, S. K., Long, R. J., & Kang, M. Y. (2003). Milking and milk processing: traditional technologies in the yak farming system of the Qinghai-Tibetan Plateau, China. *International Journal of Dairy Technology*, *56*(2), 86–93. http://doi.org/10.1046/j.1471-0307.2003.00088.x

Farkye, N. Y. (2004). Cheese technology. *International Journal of Dairy Technology*, *57*(2-3), 91–98. http://doi.org/10.1111/j.1471-0307.2004.00146.x

Fox, P. F., McSweeney, P. L. H., Cogan, T. M., & Guinee, T. P. (2004). *Cheese: Chemistry, Physics and Microbiology: General Aspects*. Academic Press. Retrieved from https://books.google.com/books?hl=en&lr=&id=a95C5Nza5_EC&pgis=1

Høier, E., Janzen, T., Rattray, F., Sørensen, K., Børsting, M. W., Brockmann, E., & Johansen, E. (2010). The Production, Application and Action of Lactic Cheese Starter Cultures. Retrieved from http://agro.afacereamea.ro/wp-content/uploads/carti/Technology of Cheesemaking.pdf#page=194

Ilich, J. Z., & Kerstetter, J. E. (2000). Nutrition in Bone Health Revisited: A Story Beyond Calcium. *Journal of the American College of Nutrition*, *19*(6), 715–737. http://doi.org/10.1080/07315724.2000.10718070

Leroy, F., & De Vuyst, L. (2004). Lactic acid bacteria as functional starter cultures for the food fermentation industry. *Trends in Food Science & Technology*, *15*(2), 67–78. http://doi.org/10.1016/j.tifs.2003.09.004

Pyakuryal, B., Roy, D., & Thapa, Y. B. (2010). Trade liberalization and food security in Nepal. *Food Policy*, *35*(1), 20–31. http://doi.org/10.1016/j.foodpol.2009.09.001

Reid, J. T., Moe, P. W., & Tyrrell, H. F. (1966). Energy and Protein Requirements of Milk Production. *Journal of Dairy Science*, *49*(2), 215–223. http://doi.org/10.3168/jds.S0022-0302(66)87833-5

Scott, R., Robinson, R. K., & Wilbey, R. A. (1998). *Cheesemaking Practice*. Springer Science & Business Media. Retrieved from https://books.google.com/books?hl=en&lr=&id=NEItzh7YTqAC&pgis=1

Siso, M. I. G. (1996). The biotechnological utilization of cheese whey: A review. *Bioresource Technology*, *57*(1), 1–11. http://doi.org/10.1016/0960-8524(96)00036-3

Sternberg, M. (1977). *ADVANCES IN APPLIED MICROBIOLOGY, Volume 20*. Academic Press. Retrieved from https://books.google.com/books?hl=en&lr=&id=_jvQV-v2ij0C&pgis=1

Swiss Mountain Cheese kit using calf rennet powder | Danlac Canada Inc. (n.d.). Retrieved December 1, 2015, from http://www.danlac.com/ingredient/swiss-mountain-cheese-kit-using-calf-rennet-powder

Walther, B., Schmid, A., Sieber, R., & Wehrmüller, K. (2008). Cheese in nutrition and health. *Dairy Science and Technology*, *88*(4-5), 389–405. http://doi.org/10.1051/dst:2008012

Zurick, D. N. (1992). Adventure Travel and Sustainable Tourism in the Peripheral Economy of Nepal. *Annals of the Association of American Geographers*, *82*(4), 608–628. http://doi.org/10.1111/j.1467-8306.1992.tb01720.x