J. Phytol. Res. **28** (1 & 2) : 1-6, 2015 **ISSN 0970-5767**

PRODUCTION OF PICKLE FROM CAULIFLOWER PETIOLE STUDS

SUMITRA NAI and GAUTAM KUMAR MEGHWANSHI*
Department of Microbiology, M. G. S. University, NH-15, Jaisalmer Road, Bikaner-334004, India
* Corresponding author : E-mail: drgkm_biotech@yahoo.com

Pickling is an ancient method of food preservation. Pickles are produced from both vegetable and animal sources. However, vegetable based pickles are safer to use for humans as the chances of occurrence of food borne pathogens like *Salmonella* and *Shigella* is more common in unhygienically processed meat based products. In the present investigation, vegetable waste especially, the waste part of cauliflower i.e. the petiole studs which are either thrown away or fed to animals has been used for the production of an edible pickle having good aroma, taste and nutritional value.

Key words: Amla; Bitter gourd; Carrot; Cauliflower; Chilli; Lactic acid bacteria; Pickles; Sangri.

Introduction

Vegetables are good sources of natural antioxidants such as carotenoids, vitamins, flavonoids, other phenolic compounds, minerals and dietary fibers[1,2]. Historically, various vegetables such as cauliflower, cucumbers, cabbage, olives, radish, carrot, green peppers and also raw meat products have been subjected to lactic acid fermentation. During the process traditionally a spontaneous fermentation process occurs. Generally, the LAB isolated from the spontaneous pickle fermentation are *Lactobacillus plantarum, L. brevis, Leuconostoc mesentereoides, Pediococcus pentosaceus* and *Enterococcus faecalis*[3-5].

Lactic acid bacteria produce several antimicrobials, such as organic acids (lactic, acetic, formic, caproic acids) carbondioxide, hydrogen peroxide, diacetyl, ethanol, bacteriocins, and they can prevent mould spoilage. Chemical food additives such as propionic acid, sorbic acid and benzoic acid are commonly applied in pickle preservation. However, LAB which is safer and non-hazardous to humans can be used in vegetable fermentation technology and in pickle industry as an alternative to the chemical preservatives[6].

World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommended intake of a specific dose of vegetable and fruits in daily food to prevent chronic pathologies such as hypertension, coronary heart problems, and risk of strokes. The consumers tend to prefer the foods and beverages which is fresh, highly nutritional, health promoting and ready to eat or ready to drink[7].

Lactic acid (LA) fermentation of vegetables and fruits is a common practice to maintain and improve the nutritional and sensory features of food commodities[8-10] A great number of potential lactic acid bacteria

(LAB) have been isolated from various traditional naturally fermented foods[11]. Asian traditional fermented foods are generally fermented by LAB such as *Lactobacillus plantarum*, *L. pentosus*, *L. brevis*, *L. fermentum*, *L. casei*, *Leuconostoc mesenteroides*, *L. kimchi*, *L. fallax*, *Weissella confusa*, *W. koreenis*, *W. cibaria*, and *Pediococcus pentosaceus*[6,9,10]. Availability of certain specific nutrients such as vitamins, minerals, and acidic nature of fruits and vegetables provides conducible medium for fermentation by LAB.

The head part (white curd) of cauliflower is used for the preparation of different types of vegetable curries, pakodas (Indian deep fried snacks), pranthas (fried Indian wheat bread) and also for the preparation of its pickle. However, in the present research work, the aim was to prepare some edible product from the petioles studs of cauliflower which is normally a waste part and is thrown away or used to feed animals. Earlier research works have show that cauliflower has high nutritional value but low calories. It rich in antioxidants, and also have anticancerious properties.

Thus realizing the nutritional value of cauliflower, its petiole studs (waste part) were used as a substrate for the production of pickle using the microbial culture isolated from different pickle samples.

Materials and Methods

Pickles of different vegetables & fruits viz. Carrot, Mango, Amla, Bitter gourd and Sangri were purchased from the local market. Media like nutrient broth, nutrient agar, different salts of metals, buffers etc. were purchased from Himedia, India. All the reagents and chemicals used were of analytical grade.

Isolation of Lactic acid bacteria from different pickles: With the help of a sterile loop, pickle samples were streaked on to NA plates containing 1% NaCl. The inoculated plates were incubated for 24 hours at 37 °C. Colonies so obtained were re-streaked on to NA plates containing 2% NaCl followed by 3% NaCl. Finally the colonies which grew on 3% NaCl containing NA plates were subjected to repeated quadrate streaking to get isolated pure colonies. Each colony was observed under microscopic for checking its purity. The pure culture was maintained on 3% NaCl containing NA slants. The cultures so obtained were used for the production of pickle from cauliflower petiole studs (waste part).

Morphological and Biochemical Characterization of LAB cultures: The LAB culture isolated from different pickles was characterized morphologically and biochemically.

Production of Pickle from the Cauliflower Studs: Cauliflower petiole studs were washed 2-3 times and cut into small pieces with the help of a clean knife. These pieces were soaked thoroughly in salted luke warm water for 10 minutes. The Pieces were drained in sun light for 2-3 hours. Chilli powder, Turmeric powder, Salt, Fenugreek seeds (soaked in lime juice overnight), Fennle seeds, Black cumin seeds, Mustard seeds were added to petioles pieces in desired amount and mixed well. This mixture was distributed in six clean and dry jars. Thereafter boiled and cooled mustard oil was added to each jar. The LAB culture isolated from different pickles was added at a concentration of 5% v/v (grown overnight in NB at 37 °C, and 150 rpm) into separate jars (one for each culture). One jar was inoculated with mixed cultures i.e. 1 ml each form Carrot, Mango, Amla, Bitter gourd and Sangri LAB cultures. A control was also kept, in which no external culture was added. The jars were tightly closed and kept

at room temperature for three month. Samples from each jar were withdrawn after every 15 days and were observed for drop in pH, aroma, maturity and taste.

Results and Discussion

Isolation of Lactic acid bacteria from different pickles: Streaking of different pickle samples viz. Carrot, Mango, Amla, Bitter gourd and Sangri pickle on modified NA plates (3% NaCl) showed that in each case there was growth of a single type of bacterial colony. The reason behind this may be that probably there was only one predominant LAB culture present in each pickle or the other type of cultures which might have been present, were unable to grow on the NA plates.

Morphological and Biochemical Characterization of LAB cultures

The results of morphological and biochemical tests are presented in table 1 & 2.

Table: 1 Colony characteristics of Lab cultures isolated from pickles

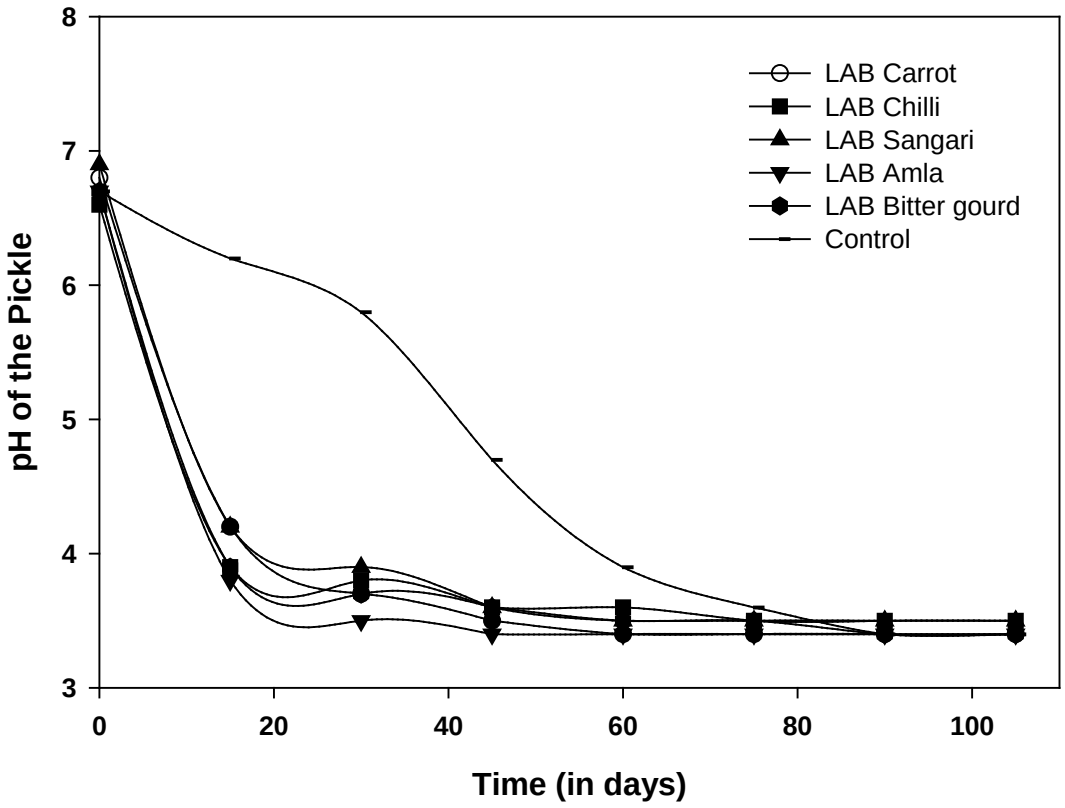
S. No.	Culture/Sample name	Colour	Shape	Gram's reaction	Cell Shape
1.	Carrot	White	Circular	+	Rod
2.	Mango	White	Circular	+	Rod
3.	Sangri	White	Rhizoid	+	Rod
4.	Amla	White	Rhizoid	+	Rod
5.	Bittergourd	White	Circular	+	Rod

Table 2: Biochemical characterization of LAB cultures isolated from different pickles

S. No.	Test	LAB Source				
		Carrot	Chilli	Sangri	Amla	Bitter gourd
1.	Amylase production	+	+	+	+	+
2.	Cellulase production	-	-	-	-	-
3.	Lipase production	+	+	+	+	+
4.	Protease production	+	+	+	+	+
5.	MR test	+	+	+	+	_
6.	VP test	-	-	+	-	-
7.	Catalase test	+	+	+	+	+
8.	Hydrogen sulfide production test	-	-	-	-	-
9.	Indole test	-	-	-	-	-
10.	Carbohydrate fermentation test					
	(i) Lactose	-	-	-	-	-
	(ii) Sucrose	+	+	+	+	+
	(iii) Dextrose	+	+	+	+	+

Production of Pickle from the Cauliflower Studs: The result of pickle production from cauliflower studs using LAB cultures isolated from different pickles showed that pickling was very fast in test samples where 5% of LAB cultures were added at the start of the process, resulting in complete pickling of the cauliflower studs within 30 days. The pickling was evaluated in terms of taste of the studs i.e. whether raw or pickled, change in aroma & colour and change in pH of the substrate with reference to increasing time. The results of change (drop) in pH with time, was an indirect measure of ongoing fermentation and are presented in Fig. 1.

Fig. 1: Change in pH of Cauliflower stud pickles in response to time



From Fig. 1 it can be observed that in all test experiments where external LAB cultures were added to the stud mixtures, the processes of fermentation/pickling was very fast causing a faster drop in pH from near neutral to acidic in i.e. pH 3.7 in 30 days. However, there was no further drop in the pH, probably due to the consumption of fermentable sugars by the LAB cultures in 30 days. Whereas, in the control where no external culture was added the pickling process was slow, which was evident from the slow drop in pH, taking around 90 days in achieving a stable pH of 3.4. These observations denote that when external cultures were added for the purpose of pickling the process became fast and as there was no lag in growth and proliferation of LAB cultures, they took short time to occupy the substrate and started the process

of fermentation much earlier than the control experiment, thereby resulting in less time in completion of the pickling process. The sensory qualities like aroma, appearance and taste of all the pickles produced were comparable to the traditionally produced cauliflower pickle. So it can be concluded that present process of pickling of cauliflower studs (which otherwise are waste for humans) can be used to convert the studs into nutritive and healthy pickle which is assumed to be a rich source of vitamins, flavonoids, other phenolic compounds, minerals and dietary fibers[1,2,12,13].

Table 3: Properties of Cauliflower stud pickles produced by LAB cultures

S. No.	Charcteristics	LAB *(Carrot pickle)	LAB *(Chilli pickle)	LAB *(Sangri pickle)	LAB *(Amla pickle)	LAB *(Bitter gourd pickle)	#Control
1.	Colour	Pale green	Pale green	Pale green	Pale green	Pale green	Pale green
2.	Aroma	Good, acidic	Good, acidic	Good, acidic	Good, acidic	Good, acidic	Good, acidic
3.	pH	3.7	3.8	3.6	3.9	3.7	4.4
4.	Taste	Similar to Cauliflower pickle	Similar to Cauliflower pickle	Similar to Cauliflower pickle	Similar to Cauliflower pickle	Similar to Cauliflower pickle	Similar to Cauliflower pickle

***Source of the LAB culture, # No external culture was added**

References

1. Sun T, Simon PW and Tanumihardjo SA 2009, Antioxidant phytochemicals and antioxidant capacity of biofortified carrots (*Daucus carota* L.) of zarious colors. *J. Agric. Food Chem.* **57** 4142–4147.
2. Kusznierewicz B, Piekarska A, Mrugalska B, Konieczka P, Namieśnik J and Bartoszek A. 2012, Phenolic Composition and Antioxidant Properties of Polish Blue-Berried Honeysuckle Genotypes by HPLC-DAD-MS, HPLC Postcolumn Derivatization with ABTS or FC, and TLC with DPPH Visualization. *J. Agric. Food Chem.* **60** 1755–1763.
3. Jagannath A, Raju PS and Bawa AS 2012, A two-step controlled lactic fermentation of cabbage for improved chemical and microbiological qualities. *J Food Qual.* **35** 13–20.
4. Kabak B and Dobson AD 2011, An introduction to the traditional fermented foods and beverages of Turkey. *Crit. Rev. Food Sci. Nutr.* **51** 248–260.
5. Gardner NJ, Savard T, Obermeier P, Caldwell G and Champagne CP 2001, Selection and characterization of mixed starter cultures for lactic acid fermentation of carrot, cabbage, beet and onion vegetable mixtures. *Int J Food Microbiol.* **64** 261-275.

6. Wedajo B 2015, Lactic acid bacteria: benefits, selection criteria and probiotic potential in fermented food. *J. Prob. Health.* **3**1-9.
7. Endrizzi I, Pirretti G, Calo DG and Gasperi F 2009, A consumer study of fresh juices containing berry fruits. *J. Sci. Food Agric*. **89** 1227–1235.
8. Di Cagno R, Coda R, De Angelis M and Gobbetti M 2013, Exploitation of vegetables and fruits through lactic acid fermentation. *Food Microbiol.* **33** 1-10.
9. Ghaffara T, Irshada M, Anwara Z, Aqilb T, Zulifqara Z, Tariqa A, Kamrana M, Ehsana N and Mehmood S 2014, Recent trends in lactic acid biotechnology: a brief review on production to purification. *J. Radiat. Res. Appl. Sci*. **7** 222-229.
10. Swain MR, Anandharaj M, Ray RC and Rani RP 2014, Fermented fruits and vegetables of asia: a potential source of probiotics. *BioMed Res. Int*. **2014** 1-19.
11. Saez-Lara MJ, Gomez-Llorente C, Plaza-Diaz J and Gil A 2015. The role of probiotic lactic acid bacteria and bifidobacteria in the prevention and treatment of inflammatory bowel disease and other related diseases: a systematic review of randomized human clinical trials. *BioMed Res. Int*. **2015** 1-15.
12. Stankus, T 2014, Pickled vegetable condiments: a global industry and its literature. *J. Agr. Food Inform*. **15** 3–18.
13. Kasote DM, Katyare SS, Hegde MV and Bae H 2015, Significance of antioxidant potential of plants and its relevance to therapeutic applications. *Int J Biol Sci*. **11** 982–991.