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Abstract

This investigation was carried out to utilize whey and rice in manufacturing nutritious product with therapeutic virtue at a ratio of 1:10 rice to whey (w/w).The products were fermented for 8 days by lactic acid bacteria (LAB) starters that comprised each of *Lb.acidophilus (Lb.a.), Lb.casei (Lb.c.)* and their mixes at the ratios ; 1a:1c,1a:2c,and 2a:1c. The best fermentation period was 2 days as highest therapeutic bacterial counts were resulted.
The fermented products via each of the five starters, were subjected to frozen storage at -18°C for 4 months. Other samples of fermented products were dried at 45°C and then stored at room temperature (25°C) for 3 monthes.
Chemical composition, titratable acidity, pH, total soluble solids content (T.S.S.), LAB count were determined for the processed products. The dried fermented product was subjected to organoleptic assessment.
A filterate was obtained from each of fermented product to examine it's effect on three different bacterial pathogens. The dried fermented product was subjected to the same treatment.
The obtained results were as follows :

1-The chemical analysis revealed that whey contained 93.66, 5.27, 0.48, 0.3, 0.29% for moisture, carbohydrates, protein, fat, and ash, respectively. The total solids (T.S.) was 6.34%.
2-There was a significant increase($p \leq 0.05$) for rice cooked with whey that valued 34.6 , 489.7 , and 389.6% for protein, fat, and ash, respectively, carbohydrates content dropped by 6.8% as compared with dry rice
3-The *Lb.acidophilu*s exelled *Lb.casei* in total counts for all five starters. There was obvious increase for both starters *Lb.*(*1a:1c*) and *Lb.*(*2a:1c*) compared with both single starters, the total count dropped in mixed starter *Lb.*(*1a:2c*) .
4-The pH value dropped significantly($P \leq 0.05$) for the product(rice cooked with whey) fermented by five starters from initial value6.53 to 4.30 on the $1^{st.}$ fermentation day by both *Lb.a*. and *Lb.*(*2a:1c*) specifically.The drop continued for all treatments reaching the lowest value of 4.0 on the$7^{th.}$day of fermentation period by *Lb.a* .
5-The titratable acidity of the fermented product increased to reach highest value on the $4^{th.}$ day of fermentation period for *Lb.c*.,*Lb.*(*1a:1c*) and *Lb.*(*1a:2c*) that valued 0.56, 0.63, 0.53 % respectively. As for both *Lb.a*. and *Lb.*(*2a:1c*), the values the $7^{th.}$ day of fermentation period. were 0.81 and 0.77 %,respectively
6-There were insignificant differences ($p \leq 0.05$) in T.S.S.% among the fermented product treatments by mixed starters over fermentation period. However, the values for both single starters were higher.The obtained results also showed that the T.S.S.% for the treatment of th fermented products by mixed starters increased significantly to 5% on the $1^{st.}$ fermentation day, while the T.S.S.% for products fermented by each of *Lb.a*. and *Lb.c.* reached 1.1, 2.0%, respectively. The rise continued to reach highest value of 5.0% on the $8^{th.}$ day for *Lb.a*. and on the $7^{th.}$ day for *Lb.c.*treatments, respectively, while the T.S.S.% for mixed starters treatments reached the highest value of 6.0% on the $3^{rd.}$day of fermentation period and persisted at this level towards the end of fermentation period.
7-The LAB counts rose for all five product treatments during fermentation period. The highest number obtained on the $2^{nd.}$ day.The product obtained by mixed starters fermentation, namely *Lb.*(*1a:1c*), *Lb.*(*2a:1c*) contained highest bacterial count of 8.65×10^{10} and 4.47×10^{10} *cfu/ml*, respectively,on the $2^{nd.}$ day of fermentation process. Thus this period was selected for storage trials.
8-The chemical analysis for the processed products showed significant differences ($p \leq 0.05$),as carbohydrates content dropped for all treatments.The highest and

lowest drops were13.44, 6.30% for products fermented by *Lb.a*. and *Lb.c*., respectively,while,both protein and fat contents increased significantly($P \leq 0.05$) for all treatments, the highestrise was 26.59% for protein and 359.5% for fat, for *Lb*.(*1a:1c*) and *Lb.a*. products, respectively, while the lowest rise of 4.5% for protein and 135.2% for fat, was obtained for *Lb*.(*2a:1c*), *Lb*.(*1a:1c*) products, respectively.The increase rate for ash was 17.06 and 84.126% for *Lb*.(*2a:1c*) and *Lb*.(*1a:2c*),respectively.

9-The frozen fermented product stored for 4 months revealed significantdifference($p \leq 0.05$) in titratable acidity that ranged between 0.43 – 0.85% for *Lb.c*., *Lb*.(*1a:1c*) treatments, respectively. As for pH, value ranged between 3.63–4.72 for *Lb*.(*1a:2c*) and *Lb.c*., respectively.However, the frozen storage hasn't effected pH values of the product.The LAB counts dropped for all processed products during frozen storage for 4 months. The drop ranged between 19.14 – 60.05% for *Lb.a.* and *Lb*.(*1a:2c*), respectively.

10-The titratable acidity for treatments of dried fermented product ranged between 0.33 – 0.66% and became 0.46 – 0.75% after 3 months of storage. The highest pH value of 4.5 was obtained for *Lb.c.* product after drying. There was a slight drop in pH value of all dried products after 3 months of storage.

11-The LAB counts dropped for all products after drying. The highest count of 5.48×10^{10} *cfu /ml,* was obtained for *Lb*.(*1a:2c*). A drop of 34.88–71.71% occurred in the LAB count for *Lb*.(*1a:2c*) and *Lb*.(*1a:1c*), respectively, and in spite of that the LAB counts remained acceptable to impart therapeutic character to the products.

12-The filtrate of LAB obtained from products fermented for 2 days exerted inhibitory effect on tested bacteria. *Staphylococcus aureus* was the most liable, while *E.coli* being the least. The obtained resul revealed significant differences ($p \leq 0.o5$) between *Lb.a.* and *Lb.c.* filterate upon tested bacteria.

13-The activity of LAB filterate obtained from products after drying dropped with the same products before drying. There were significant differences($p \leq 0.05$) among diameters of inhibition zones of tested bacteria, for different product treatments. The largest inhibition zone diameters were for *Lb.a*.product, which valued 12.36, 16.50,and 15.16 *mm* for *E.coli.*,*Staph.aureus* and *B.subtilis*, respectively. The inhibition effects of products filterates decreased gradually during storage period, so that the inhibition zones diameters became smaller for *Lb.a.* treatments at rate of 48.86, 40.0,and 43.07% for *E.coli*, *Staph. aureus*,and *B.subtilis*,respectively.

14-The sensory assessment results revealed that the product treatment *Lb*.(*2a:1c*) exceeded significantly ($p \leq 0.05$) the other products, as far as taste,odor, and texture are concerned. While the product *Lb*.(*1a:2c*) was significantly better for both appearance and overall acceptability . However, the above mentioned treatments obtained top scores compared to other treatments