

**PRODUCT DIVERSIFICATION OF TEA (*Camellia sinensis*) IN NON-AERATED GREEN TEA, TEA FORTIFIED ALCOHOLIC BEVERAGES AND YOGHURTS FOR ENHANCING VALUE ADDITION IN THE TEA INDUSTRY**



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## ABSTRACT

Tea (*Camellia sinensis*) product diversification is at the moment in its infancy stages in Kenya because focus is on aerated black tea. Prices of this product are constantly fluctuating hence the need for product diversification to make the tea prices stable and the industry more profitable. This research aimed at contributing to tea product diversification and value addition in four areas namely the development of; non-aerated green tea, alcoholic beverages and yoghurts fortified with black, green and purple tea and evaluation of the health effects of ingesting the tea fortified products using mice. Research on non-aerated green tea focused on the evaluation of the physico-chemical qualities of the teas with respect to fertilizer rates and seasons. Work on tea fortified alcoholic beverages and yoghurts focused on product development, physico-chemical, microbial and sensory assays of products. Research on health effects focused on evaluating effects of ingestion of the tea fortified products by experimental mice. The physico-chemical assays included the use of UV spectrophotometer for polyphenol assay, High performance liquid chromatography (HPLC) for catechin assay and an Inductive Couple Plasma Emission Spectrophotometer (ICPE) for mineral assay. A micro-titre plate reader was used to assay Glutathione (GHS) while a biochemical analyzer was used to assay total proteins, albumin and alkaline phosphatase. Microsoft Excel, Statistical analysis Software (SAS) and Graphpad statistical packages were used for data analysis of mean, standard deviation, Coefficient of variance and Analysis of Variance (ANOVA). Results revealed that fertilizer application increased polyphenols, catechins and non catechin compounds including gallic acid and caffeine up to 400kgN/ha/yr. The cold and dry seasons as well as the cold and wet seasons increased the polyphenol and catechins of the teas. Nitrogen (N), phosphorous (P) and potassium (K) increased with fertilization up to a maximum of 400KgN/ha/yr and thereafter stagnated or decreased. Minerals increased during the cold and wet season as well as with the hot and wet seasons. In the development of tea fortified alcoholic beverages 6 and 12% (v/v) Alcohol contents were developed. Tea enhanced alcoholic fermentation and yeast proliferation. Teas also increased polyphenols and antioxidants of the alcohols as well as their sensory ratings. The profiling of alcohols revealed the presence of no harmful alcohols in tea fortification. Microbial safety of alcohols was within acceptable limits. Research on tea fortified yoghurts revealed that teas could successfully develop yoghurts with beneficial gut microorganisms and tea polyphenols at fortification up to 4g/250mL. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* survived



at rates between  $10^6$  and  $10^8$  cfu/mL. However there was increased yoghurt culture time ranging from 5.5-8.3hrs with tea addition. Tea flavours of up to 4g/250mL were acceptable to most evaluators. The tea fortified yoghurts' microbial safety was within the acceptable quality ranges even after 63 days of storage. Tea imparted hepatoprotective effects in mice against alcohol induced toxicity supplementation with tea fortified alcoholic beverages. Tea fortification of yoghurts also exhibited effects of enhanced alkaline phosphatase activity, glutathione, total protein and albumin in mice supplemented with tea fortified yoghurts compared to controls which promoted good health. Research findings on non-aerated green tea will guide producers and processors on production and processing of quality non-aerated green teas. Developed technologies on tea fortified alcoholic beverages and yoghurts will boost tea value addition and production of health foods, making tea more profitable. In addition the yeast, baking and alcoholic beverage industry will benefit from the research findings on effects of tea in boosting alcoholic fermentation. The health benefits of the tea products will promote the consumption of tea and tea fortified products for health aspects.

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