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Agriculture Intensive dans les Iles de la Caraibe : enjeux, contraintes et perspectives
Intensive Agriculture in the Caribbean Islands : stakes, constraints and prospects
Agricultura Intensiva en la Islas del Caribe : posturas, coacciones y perspectivas

MINIMUM PROCESSES FOR CARIBBEAN FRUITS AND VEGETABLES

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The processing of fruits and vegetables, in the Caribbean context, should have the objective of exploiting the inherent condition-low capitalization, abundant tropical heat, and fruits and vegetables possessing some of the world's most exotic flavors. The region's chronically low level of funding precludes elaborate processing facilities in many of the island states and territories. Fortunately, success does not necessarily correlate with the magnitude of the investment, and size and quality are not synonymous. All fruits may be "candied" by simple, natural or artificial dehydration; all juices can be easily fermented into wine; all starchy vegetables can be readily converted to "instant" flakes, meals and powders. These processes are examples of relatively inexpensive technologies that are capable of adding high value to cheap produce. Universal models, seldom adaptable to small-scale production, will fail, given the region's limiting population size and rawmaterials resource base. Unique Caribbean models, of the order of cottage industries, relying principally on the indigenous and regional markets, accordingly modified to accommodate the cheapest means of inter-island transport, need to be advanced. Continental trade will inevitably follow. First principles of such a model should be good manufacturing practices, common regulatory standards, and enforcement mechanisms.

RAW MATERIALS AND PACKAGING

The best product is made from the best raw materials and substrate, inasmuch as no amount of processing can improve fruits and vegetables over the original raw product. Moreover, the output is proportional to the input, qualitatively and quantitatively.

The greatest protection offered a fruit or vegetable is its pericarp, seed-coat, or other barrier structures. Stripped of this protection, the biologically unstable interior becomes exposed to the adverse consequences of a deteriorative environment. Fabricated foods must be packaged similarly in artificial containers (cans, films, *etc.),* evincing the necessity of a critical, minimum capitalization.

REFRIGERATION, DEHYDRATION AND FERMENTATION

The closest facsimile to fresh fruit and vegetable quality is refrigerated fruit and vegetable quality, perhaps the singular difference being a loss of flavor and texture with time, under refrigeration. Arguably, some flavors, *e.g.,* banana and mango flavours, improve with post-harvest age. Refrigeration merely slows the natural, deteriorative processes irreversibly intiated after maturation.

Energy is the costliest component of fruit and vegetable processing. In the Tropics, refrigeration warrants a continual expenditure of electrical energy to remove heat from foodstuff. This is an exercise that is antithetical to the Caribbean tropical environment in which mean annual temperatures are perennially high and relative humidity is normally perennially low, in contrast to temperate latitudes where mean annual temperatures are perennially lower, and relative humidity is perennially higher. The corollary of this circumstance is that dehydration is a logical minimum process in the Caribbean. The example of dates *(Dactylus) is* but one reminder of how exotic the tastes and flavours derived from controlled sun-drying can be.

Fermentation is as cost-effective as drying, since there might be no more investment than in simple systems. Fermentation, as ripening, generates uniquely attractive flavours in and from fruits and vegetables. We are all·too familiar with vinegar and wine, products of acetic and alcohol fermentation, respectively.

SALTING AND ACIDIFICATION

The Caribbean has a traditional familiarity with salting,

because of its history of importation, when meat and fish were shipped corned. Temperate-climate food manufacturers have extended and refined this preservation technique, having now applied it to plant tissues and organs. It is noteworthy that salted chickpeas and peanuts are a temperate-climate delicatessen.

Acidification is yet another simple technology producing premium products; for example, Sweet pickles result from a combination of an inexpensive raw material (cucumber), fermentation, freshening (desalting) and packing in a weak spiced solution of vinegar. They too are a delicatessen and cocktail item in temperate-climate countries.

GOOD MANUFACTURING PRACTICES (GMP)

GMP is a body of mandatory and advisory regulations for food processing compiled by the U. S. Food & Drug Administation, outlining the requirements of proper sanitation, products, processes and a generally favorable work environment. The objective of the regulations is to help insure food fit for human consumption, free of adulteration whose definition covers preparation, packaging and holding, which should not be under filthy conditions. One of the more important aspects of the regulations is the training of inspectors in food technology.

GMP considers microbial spoilage of food also, and consequently mandates thermal processes by first distinguishing between low-acid and high-acid foods. The highly lethal toxin of the bacterium, *Clostridium botulinum, is* not generated below about pH 4.6; so food substrate below this value is permitted to be simply heated to 100 °C and packaged in clean containers. This mild thermal process serves to kill yeasts, molds and bacterial vegetative cells. Above pH 4.6, more intensive heating is required to destroy *Clostridium* spores that may vegetate and produce toxin in the container. The time-temperature integral for food substrate containing pH higher than 4.6 should insure a minimum interval of three minutes at 250 °C (excluding the time for the heating system to reach 250 °C), thereby necessitating cooking under pressure in retorts.

REGULATORY STANDARDS

There are two kinds of standards, viz., identity and quality standards. The former define food, so that there is no ambiguity in its selection; the latter give assurance of how the product was formulated and processed. Without standards of identity, a name designation could mean different products, and different products could be identified by the same name. Quality standards guarantee a certain wholesomeness, without the consuming public's having to undertake inspection from container to container of the same labelled food product.

The International Organization for Standards, Geneva, Switzerland, and the *Codex Alimentarius* of the World Health Organization and the Food and Agricultural Organization of the United Nations, promulgate standards for the processing of fruit and vegetables.

ENFORCEMENT

Standards are meaningless, unless they have the coercive power of law. Enforcement should provide for recalling from the marketplace foods judged to be underprocessed, or in any other way adulterated or misrepresented.

TOXICOLOGY

It is well known that many natural products contain toxic substances, albeit in small quantities. It should be borne in mind that processes that concentrate a food material, *e.g.*, dehydration, simultaneously concentrate harmful as well as beneficial food components. In the absence of elaborate toxicological testing, safety is assured by the concept of GRAS (generally recognized as safe), determining harmlessness on the basis of previous scientific evaluation or by the history of the product, in the context of its actual or anticipated use as food. The GRAS list, compiled by the U. S. Food and Drug Administration, contains such ingredients as common salt, fatty acids and gums.

THE QUALITY CONTROL LABORATORY

A chemical and biological laboratory is indispensable to any program of fruit and vegetable processing. Quality criteria are best assured by physical and chemical analyses of the raw materials and the final product. Adherence to specifications is the responsibility of the produce chemist and microbiologist. In advanced processing plants, not only are rawmaterials purchases quite frequently predicated on objective, analytical data *(e.g.,* moisture and fibre contents, size uniformity and microbial population), but the finished product can be rejected for delivery to market, if it fails to meet objective criteria of texture and appearance.

QUALITY ASSURANCE PROGRAMME

Whether a process or a product succeeds will be determined ultimately by consumer purchases. The manufacturer should be guided by early indications of success or failure, without having to incur the cost of commercial production before a product can be evaluated. Simple taste panels are an important instrument in preliminary and interim evaluations of the foodstuff and its intermediates, at various stages of production. A program of quality assurance should involve a method of quantitatively scoring acceptability of a wlde range of sensory attributes (taste, color, appearance, texture, *etc.).*

CONCLUSION

In the Caribbean context, the processing of fruits and vegetables should be scaled to the production capacity and economic means of the region. Minimum processing suggests the harnessing and utilization of "free" tropical heat and the mostly favorable climate. With

a minimum, critical investment, natural and cultured microorganisms can also be exploited in fermentation processes, as in temperate-climate regions, for the production of uniquely Caribbean, fruit and vegetable products.

Beyond processing, suitable packaging must insure that the final products reach the largest possible markets, geographically and temporally, in the best possible quality state. It is the marketplace that will ultimately determine the success or failure of minimum food processes.