

United Nations for Development Program



*Al servicio
de las personas
y las naciones*

PROJECT REPORT

Project: “Decontamination of Distillery Slops by Microbial Protein Propagation (DDS/MPP)”

Date: January 13th of 2015



Al servicio
de las personas
y las naciones

Cuba

PROJECT REPORT (ITP)

1. Basic information of the project

Number and title of the Project:

Number . **Decontamination of Distillery Slops by Microbial Protein Propagation (DDS/MPP)**

Associate in the implementation / National Entity for Execution:

Cuban Research Institute of Sugar Cane Byproducts (ICIDCA)

Initial date:

Expected formerly for: February 2014

Real: August 2014

Term date:

Expected formerly for: December 2015

Expected: December 2015

Report Period: August-December 2014

2. Implementation progress of the Project

State of the risks in the activity::

Definition of the risk	Action	Responsible
In relation with the commercial management it could be expected: <ul style="list-style-type: none">• Affectations in the equipment procurement, due to the specialization level that they require.• An increase of the equipment's market prices.	<ul style="list-style-type: none">• Alternatives survey of international suppliers and in some cases substitution for domestic items identified.• Planning at the very early stage of the project the more	ICIDCA

	complex inputs and beginning the bid at very early execution year. To establish a priority order for equipment acquisition.	
Readiness of transportation for local travels to Torula yeast factories, in order to accomplish project actions.	Pursuit of local contributions founded by ICIDCA, National Group AZCUBA and local industries involved in transportation supports, lodging and attention to the specialists involved in the Project tasks.	ICIDCA
Technical personnel changes that can duplicate training efforts.	<ul style="list-style-type: none"> • Pursuit system with committed institutions and local producers as for the assignment of human resources to be qualified. • To propitiate meetings through work sessions, exchanges of trouble-shot and work-shops among the qualified technicians and benefitted local industries. 	ICIDCA
Affectation in the extension of Project results and the application of the technological solutions proposed.	To encourage inside the Project demarcation with the authorities of E. G. AZCUBA for their elaboration, inclusion in its investment and research plans and the extension of the project results.	ICIDCA
Affectation in the execution of tasks planned with the resources of the participant entities.	To reprogram tasks based on other available resources among the participant entities. Cooperation among partners in the mobilization of own resources.	ICIDCA, CeBiot and UFMG
Affectation in the execution of tasks planned with UNDP resources due to delayed payments.	To reprogram tasks based on other available resources among the participant entities.	ICIDCA, CeBiot and UFMG

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Implementation problems:

Identified issue	Action
Delayed Project disbursements	<ul style="list-style-type: none">• Use of participant entities' resources, in order to continue the project progress during the first semester of the 2014.• To re-program the start of some 2014's committed tasks, for the year 2015.• Modification of strategies for the execution of some necessary actions to be executed in 2014.

3. Acting of the Project - Grade of advance toward the results achievement

Outcomes expected under UNDP strategic results (2014-2017):

- Invigoration of national and regional capacities to offer sustainable services to the generation of alternative energies and the development of measures for mitigation and adaptation to climatic change.
- Valorization of industrial residuals towards protein sources production for animal feeding.

Line of service of the MYFF that is applied:

Outputs:

1. Qualified specialists of the involved countries (scientific and technical personnel): 34
2. *Candida utilis* yeast strains assessed that grows in vinasse based media: 5
3. Calculated diets that include vinasses yeast for animal food: 4
4. Publication of results in an specialized scientific journal (Waste and Biomass Valorization/©Springer): 1
5. Consultancy material about the state of the art of the production of fodder yeast in distillery residual waters: 1

Annual goal: (year):

1. Project beginning
2. Beginning of works associated with *Candida utilis* yeast growth in distillery slops

Goal execution:

This was executed to 100%

Grade of advance in the contribution to the corporative result:

- Positive change
 Negative change
 Without changes

Outcome (Output) foreseen in the Project	Outcome 01. Project Management <u>Act. 01. Kick-off Meeting of the Project.</u> The Project Work Program was sent by the Project Manager to all the involved participants. This Program was discussed as for the implementation strategies and outputs compromised via electronic mail. <u>Act. 2. Post-graduated course about Engineering of fermentation reactions, UAM (Mexico).</u> Due to expenses delays, this activity was reprogrammed for the year 2015.
	Recommendations and actions proposed by the Official of Program - UNDP: _____ _____

Outcome (Output) foreseen in the Project	Outcome 02. Bibliographical up-date (Analysis of the state of the art) <u>Act. 1. Search of information through websites and scientific literature</u> It was gathered and updated the international knowledge and the advances in the obtaining of single cell protein starting from media formulated with distillery slops, particularizing in the cultivation of yeasts, especially of <i>Candida utilis</i> specie. Reference was made to the nutritional requirements of this organism as to macro-elements like Carbon, Nitrogen, Oxygen, Phosphorous and Sulfur as well as micro-elements. It was mentioned its
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	<p>physiologic specificities as to optimal growth parameters (temperature, pH, aeration, etc.). The bibliography points out in a comparative way the existent background in Cuba with the technological process designed from molasses and the differences with the standard technology for slops based propagation.</p> <p>The revision also includes the antecedents and current experiences of application and biological treatment of Cuban and foreign vinasses. It was stated the differences in important physical-chemical parameters that determine its potential as Carbon and energy donor substrate for high scale growth of microorganisms.</p>
	<p>Recommendations and actions proposed by the Official of Program - UNDP:</p> <hr/> <hr/>

<p>Outcome (Output) foreseen in the Project</p>	<p>Outcome 03. Procedure development</p> <p>Act. 01. Microbial growth at laboratory scale. Kinetics of growth in different vinasses components (ethanol, glycerol, etc.)</p> <p>According to characterization studies of Cuban vinasses with regard to the Carbon actual compounds, it could be detected that in its composition, important quantities of organic compounds such as alcohols, sugars and organic acids are still manifested. Its concentration reveals a high variability and it depends on such factors as the raw material and the efficiencies of fermentation and distillation process.</p> <p>Starting from these characterizations of Cuban vinasses obtained from alcoholic fermentations with molasses and filter mud juices, it could be detected among non-sugars carbon compounds, the glycerol like the most significant one, identified as a potential source of Carbon and energy for <i>Candida utilis</i> growth in supplemented media with nitrogen and pre-biotic sources.</p> <p>A part of this study approached the kinetics of growth of <i>Candida utilis</i> strain NRRL Y-660 in glycerol and ethanol as the only sources of carbon and</p>
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energy, to be the two majority components to use for this specie growing in residual waters of alcohol industry. This species was selected to be classified as General Recognized as Safe (GRAS) microorganism, its versatile metabolic profile and well-known constitutive protein value. The strain NRRL Y-660 it was selected among other strains of this specie according to kinetic parameters of growth in this substrate.

In bioreactor of 2,5 L working in a discontinuous system, values of maximum specific growth rate ($\mu_{m\acute{a}x}$) were obtained with values of 0,338 and 0,330 h⁻¹ for ethanol and glycerol respectively. In turn the biomass-substrate yields calculations (Y b/s) showed significantly similar values for both alcohols (0,641 and 0,627). These results went comparable to those obtained to a pattern with glucose for both indicators.

The obtained results were also contrasted statistically with the kinetic parameters obtained with a non- synthetic culture medium composed by vinasses/molasses 85:15 not obtaining significant differences for $\mu_{m\acute{a}x}$ (0,338 h⁻¹), but for the biomass yields whose values were very above of those obtained when formulating the growth medium with complex and heterogeneous sources (vinasses and molasses). These results allowed explaining the non-diauxic pattern in vinasses formulations, in spite of being a complex substrate.

In parallel this task approached the possible inhibitory effect of some volatile carboxylic acids as acetic, propionic and butyric in distillery slops. These compounds can be derived from molasses and by metabolism of the microbiota itself involved in alcoholic fermentation. It was detected that the inhibitory effect on the strain *Candida utilis* NRRL Y-660 it is increased in the order acetic, propionic and butyric however the detected levels in both molasses and vinasses, did not affect the $\mu_{m\acute{a}x}$ of this microorganism in a significantly way. It can be inferred that the contribution of these compounds in the organic load of this residual, besides that represent a minority, belongs to the fraction that can be biodegraded by means of the aerobic growth of this yeast species.

Act. 2. Studies on biomass composition

The obtained biomass was characterized as for its ash, total carbohydrates, lipids content, etc. among other standard indicators of quality; standing out as its more attractive properties its protein content and P₂O₅ concentration with average values of 45% w/w and 3% w/w respectively.

Considering the protein value of the product, 4 diets with this yeast included as protein additive were designed for different animal species, mentioning rumen activator nucleus, lacteous substitute for calves' artificial breeding, swinish animal food and poultry animal food.

	Recommendations and actions proposed by the Official of Program - UNDP: <hr/> <hr/>
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4. Preliminar financial information

Funds Source	PGTF
Total Budget	32 000.00 USD
Budget (2014)	13 700.00 USD
Execution (2014)	6 883.39 USD (50%)

5. Opportunities to disseminate the information

Promotion of results activities:

Publication of concerning results to characterization of Cuban vinasses obtained from an unconventional Cuban alcoholic fermentations with filter mud juices, as for their content of minority organic compounds (ethanol, glycerol, organic acids, etc.) and its potential as Carbon and energy sources for *Candida utilis* growth in supplemented media with nitrogen sources*.

Some results obtained during the year 2014 have been released by ICIDCA's Sugar and By-Product Bulletin and Novelty Bulletin by means of electronic mail, to all over national entities of National group AZCUBA (Former Cuban Sugar Ministry)

Results dissemination activities in sugar by-products local industries as beneficiaries, under the mode of technical consultancies were done.

*García, R., Izquierdo, Y., Ribas, M., Tortoló, K., Ibáñez, M., León, O., Saura, M. and Saura, G. Effects of urea supplementation on *Candida utilis* biomass production from distillery waste. Waste and Biomass Valorization (© Springer). (2014) Vol. 5 No. 1 pp. 119-124. DOI 10.1007/s12649-013-9209-z

6. Learned lessons

- It should be foreseen the risk factors that can block the acting of the Project and to have achievably alternative strategies for the committed participants. E.g. Readiness to offer participant entities' resources and facilities in case of late scheduled funds and in this way do not stop the execution of actions.

- A narrow coordination of the committed tasks with the PNUD should be settled down with the National Entity of Execution (ICIDCA) and superior organisms involved (Managerial Group AZCUBA). This will guarantee a correct readiness of logistical resources as transportation, diets, etc., as well as the redistribution of resources in case of facing risk situations.
- The obtained results should be disclosed in a systematic way not only with the scientific community through technical papers, but also to beneficiaries of the Project (local producers, animal feeders, etc.), for their correct implementation.

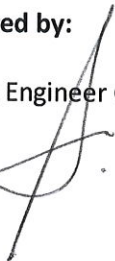
7. Work lines for acting improvement

- To explore and to put in action alternative strategies for a successful execution of the Project Work-Plan, e.g. more versatile and cheaper media and research protocols with equipment and expendable material of easy acquisition.
- The executives of the Execution National Entity and Superior Organism (Managerial Group AZCUBA) should be informed in a systematic way on the Project progress.

Prepared by:

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Sign:



Position: Project Manager

Date: 13/01/2015

Organization: Cuban Research Institute of Sugar Cane Byproducts (ICIDCA)