and ethanol. Acetic and butyric acids, CO_2, and hydrogen are also produced in small amounts.

Starch, molasses, cheese whey, Jerusalem artichoke, and lignocellulosic hydrolyzates can be used as raw material for acetone–butanol fermentations. More than one of these carbon sources may be utilized simultaneously. The composition of culture medium determines the butanol-to-acetone ratio obtained and can be manipulated to obtain the desired ratio. Molasses can be used as carbon source (6% sucrose) with the addition of nitrogen and phosphate. Higher concentrations of sucrose in molasses increase the ratio of butanol to acetone and ethanol. Average solvent yields of 30% were reported when molasses was used. Utilizing a 5–6% starch solution derived from corn, approximately 38% solvent yield can be obtained. A butanol-to-acetone ratio of 2.75 was obtained using Jerusalem artichoke rich in inulin.

Cheese whey with nearly 6% lactose and 1% protein content can be used as carbon and nitrogen source for acteone–butanol fermentation. Somewhat different product distribution is obtained when cheese whey is used as carbon source. When corn mash was also added, the butanol-to-acetone ratio was 2. With pure glucose or pure lactose this ratio is 2.7 and 2.9, respectively. When ultrafiltrate of cheese whey was used, butanol-to-acetone ratio of 10 was obtained without any intermediate buildup of acetic and butyric acids.

Lignocellulosics hydrolyzates (wood, paper, crop residues) contain glucose, galactose, mannose, and pentose sugars, most of which are fermentable by *C. acetobutylicum* to acetone and butanol. However, since hydrolysis of lignocellulosics is difficult, this raw material is not commonly used for A/B fermentations. Alternatively, cocultures with cellulolytic clostridia can be performed.

A schematic of the process is depicted in Fig. A.3. The Weizmann process utilizes starch as raw material for A/B fermentation. *C. acetobutylicum* hydrolyzes gelatinized corn starch to glucose and maltose with amylolytic enzymes. The grain mesh is first gelatinized at 65°C for 20 min and then sterilized at 105°C for 60 min. The cooked mash is cooled down to 35°C using heat exchangers and is pumped to presterilized fermenters of 250–2000 m^3. The fermenter is inoculated with a 5% inoculum from a 24 h culture. The final butanol-to-acetone ratio increases as the inoculum age increases. In some cases, 30–40% of the total volume of the mash is provided by stillage after solvents from the previous fermentation are stripped. Batch fermentation period is usually 2–2.5 days. First, rapid growth and production of acetic/butyric acids and carbon dioxide and hydrogen occur. The initial pH of the medium drops from 6.5 to nearly 4.5 during this phase. In a second phase, growth ceases, and the organisms convert acetic and butyric acids to neutral acetone and butanol. The acidity of the medium decreases, and gas production increases. At the end of the fermentation the pH is approximately 5.

The South African process utilizes cane molasses as raw material and *C. acetobutylicum*. Stainless-steel fermenters of 90 m^3 are used in batch operation. The effluent contains 2% A/B, and the solvents are recovered by distillation. Acetone/butanol and ethanol/isopropyl alcohol are obtained as separate fractions. The biomass, rich in riboflavin and B vitamins, is concentrated, dried, and used as animal feed supplement. Due to the high price of molasses this process is operated intermittently. A process based on utilization of cheese whey for production of A/B has been developed. If the plant is placed near cheese manufacturers, this process can be more attractive than that based on molasses.